...CHNOLOGY DEPT:

JULY
1945

POWER

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DETROIT

GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

Condenser bushings of giant breaker guarding power flow to Pacific Northwest plant

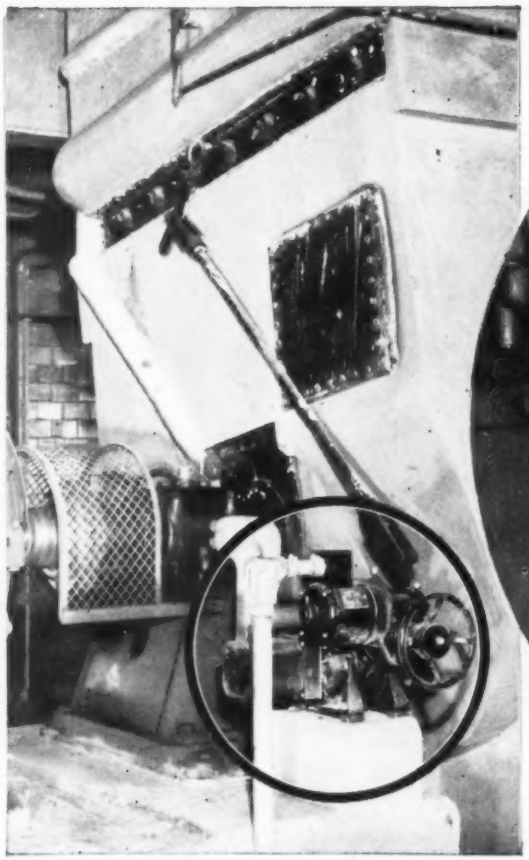
TABLE OF CONTENTS

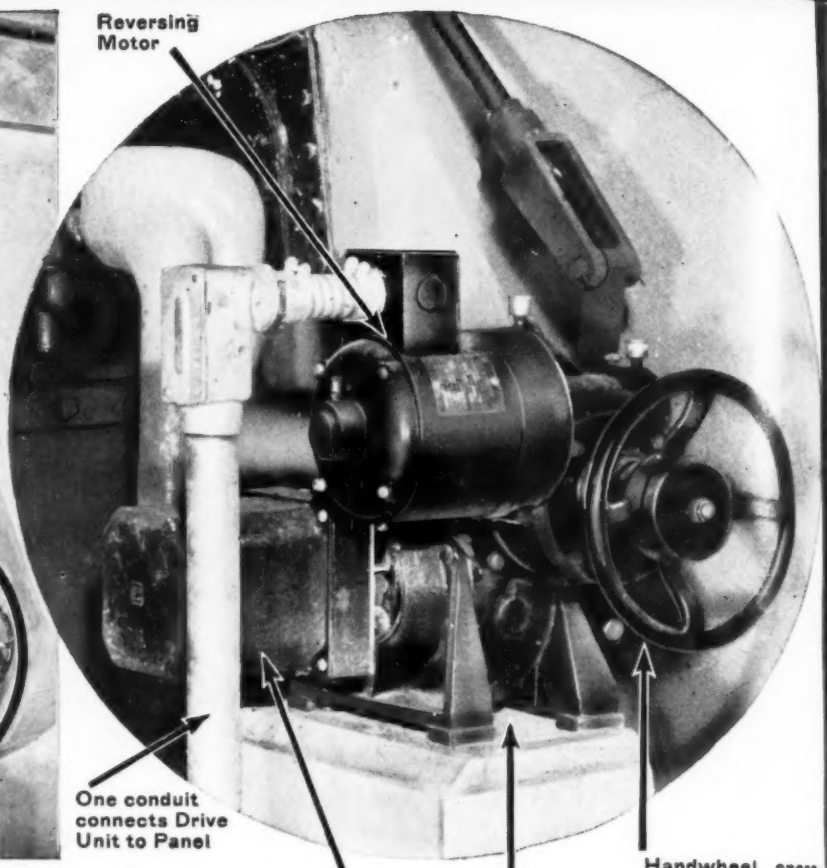
Page 59

Electronic controller cuts maximum demand by automatically switching off furnace load in steps as peak conditions approach. For details of plant-designed-and-built device, see story p 68

Flowmeter accuracy depends on proper piping arrangement before and after the primary element. Layout recommendations derived from extensive studies are outlined in article starting p 74

Metal-spraying methods make it possible to replace worn bushings or install new ones when parts cannot be obtained readily. For practical information on sprayed bushings, turn to p 104 and 122




Reversing Motor
One conduit connects Drive Unit to Panel
Handwheel operating through gears gives one-man manual control even on heavy dampers or vanes
Reduction train can't be back-driven; locks itself, eliminating lock and release devices
Adjustable Limit Switches stop elements at desired points and/or interlock them with other elements

This DRIVE UNIT Idea . . .

CAN YOUR BOILER PLANT PROFIT BY IT?

Many of the advantages which power-plant engineers find in L&N Combustion Controls are due to the Electric Drive Units which move the dampers and other controlled elements. The simplicity and dependability of the units make them fit well into the needs of any power plant.

Fuel Engineers and Boiler Operators like L&N Electric Drive Units because:

1. They move dampers, etc., smoothly and accurately. Unbalanced elements can't back-drive Units; each remains locked in place, until the Controller calls for another adjustment.

2. Remote manual control is accomplished by simple push-button stations at the Panel. Transfer to and from Automatic Control is by a single Selector Switch, for all Units.

3. Continuity of Drive Unit operation depends only on the station's electric supply.

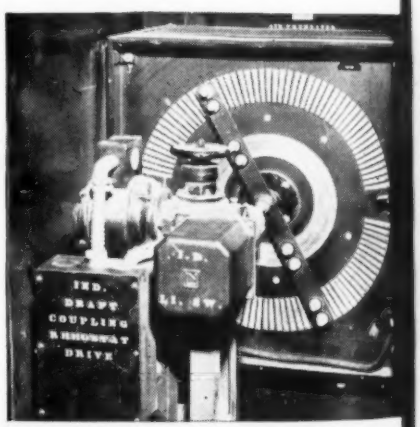
4. Units always receive full power; electric wiring is not subject to plugging or freezing.

5. Units can always be moved through handwheels. Reduction gears make this easy and also prevent unbalanced elements from snatching the wheel from the operator.

Design & Construction Engineers like the fact that Drive Units use only electric power. No prefabricated mounting stands. Units need only concrete or steel bases.

Maintenance Engineers find the attention required consists mainly of occasional cleaning and oiling.

We make Combustion Control to meet any plant's need, and will send appropriate catalog if you'll briefly outline your layout. Or an engineer will be glad to call on request.



On rheostats, drive unit connects to rheostat shaft by flexible coupling—rack and pinion eliminated. Drive units fit any plant layout.

Jrl. Ad. NU92(1)

ARMY-NAVY "E" AWARD

depends on me!

A Slogan For Every American

L&N

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), July, 1945 Vol. 89, No. 7. Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publications office, 99-129 North Broadway, Albany 1, N. Y. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter August 25, 1936, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, Power, 330 West 42nd Street, New York 18, N. Y. Please indicate position and company connection on all subscription orders. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year. $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

Announcing

A new "RUN-AROUND" Boiler Room Conveyor

The LINK-BELT SIDEKAR-KARRIER

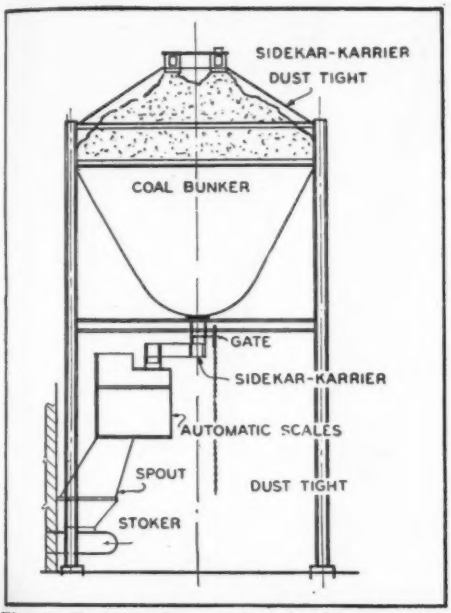
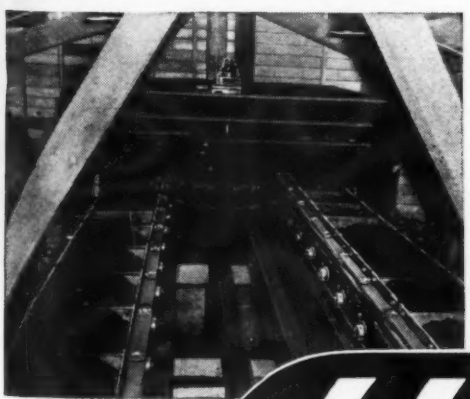


Fig. 1. Coal bunker equipped with dust-tight Sidekar-Karrier, with a similar unit feeding to automatic scales.



Above — Shows idler-sprocket end of SIDEKAR-KARRIER installation handling coal.

An Innovation in Modern Coal Handling

Indicative of the new (but tried and proved) products Link-Belt Engineers have created to meet the future requirements of industry, is this new type of conveyor. This unit has a number of features that reduce costs and improve coal handling in the power plant.

Requiring only from one to two ft. of vertical clearance, the SIDEKAR-KARRIER can be introduced in boiler plants previously equipped with overhead bunker and stoker spouts, if the installation of individual weigh scales for the boilers is desired. (See Fig. 1.)

Other advantages include: 1) Uniform feed within a horizontal path of travel, 2) Automatic discharge to several points, 3) Surplus material is recirculated in buckets until a new discharge point is found, 4) There is virtually no degradation in the conveyor, 5) There is no segregation in the conveyor, 6) Very little headroom is required, 7) Buckets and spouts are self-cleaning, 8) Less abrasion means longer life, 9) Low horsepower requirements, 10) Enclosed, no dust leakage. It is adapted to a wide range of capacities and conveyor lengths.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 9056

Send for copy of folder No. 2068 which gives complete engineering details and application data.

LINK-BELT SIDEKAR-KARRIER

GIVING EXTRA

Six B&W 550,000 lb. per hour Radiant Boilers of this design are performing notably at Burlington and Marion Generating Stations of Public Service Electric and Gas Company.

In New Jersey's critical war-plant areas, with their enormously increased load demands, power has never been "too little or too late." To the Electric Department of Public Service Electric and Gas Company belongs much credit for this distinguished war-time record. Its keen foresight and sound engineering in providing power-plant facilities capable of supplying war-urgent demands far beyond expectations are well illustrated by the performance of the Burlington and Marion Generating Stations.

In these two stations six Babcock & Wilcox Radiant boilers serve three 125,000-kw turbines, the first two boilers having been in service over 4½ years. Operating at their maximum guaranteed continuous rating most of the time, the load factor for the six boilers has averaged 81.6 per cent, and the availability factor 91.4 per cent, for a total of twenty boiler years.

These boilers have never suffered a decrease in capacity caused by slag troubles, even though they have burned low ash-fusion coals from three states and *many* different mines—coals entirely different from the normal supply.

Public Service engineers knew—as do so many other power engineers—that with the selection of B&W steam-generating equipment, all the advantages are realized from over 60 years' specialized experience in designing, fabricating, and applying boilers and related equipment having a long record of highly satisfactory service.

Thinking and planning for tomorrow *today* is a job that B&W engineers are ready to tackle—in partnership with your engineers—at any time.

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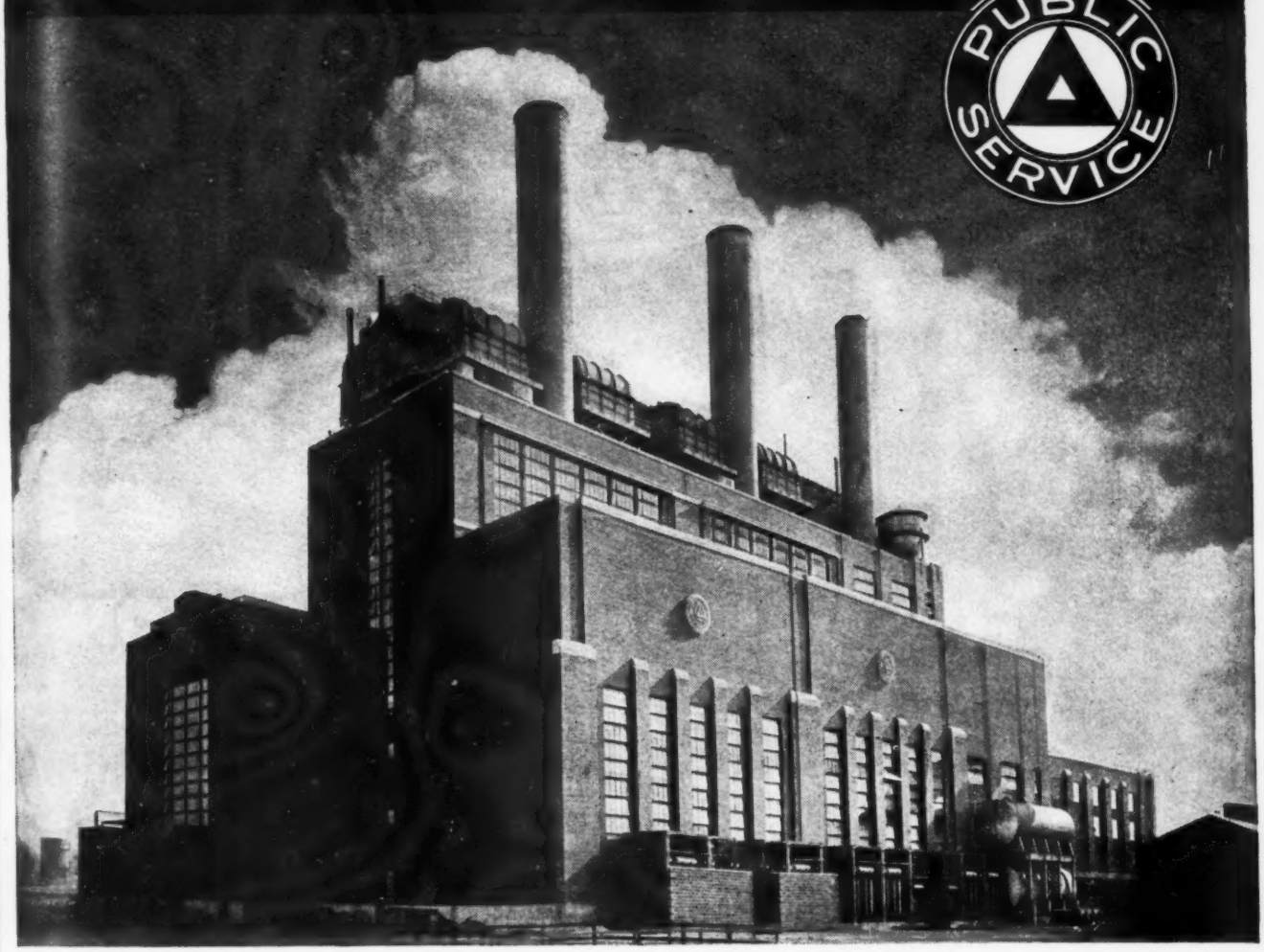


Burlington Generating Station where four B&W Radiant Boilers are supplying over 2,000,000 pounds of steam per hour.

B&W

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK 6, N.Y.

G-3008

U. S. S. Pike — from an official U. S. Navy photo.

FOR GALLANTRY IN ACTION

The U. S. submarines listed have achieved distinction either through the bestowal of the Presidential Unit Citation, or the awarding of individual honors to their personnel while engaged in operations against the enemy.

Since the success of these operations attests not only the courage and high devotion to duty on the part of officers and crew, but also dependable performance of equipment, we are more than pleased to state that all of the submarines listed (as well as many others not represented), are served by

ELLIOTT ELECTRICAL PROPELLING MACHINERY—GENERATORS, MOTORS

HONOR ROLL

U.S.S. Porpoise	Navy Cross	One Silver Star...Army D.U.B.
U.S.S. Pike	Navy Cross	One Silver Star...Army D.U.B.
U.S.S. Plunger	Navy Cross	Three Silver Stars...Three Gold Stars
U.S.S. Pollack	Navy Cross	Three Silver Stars...One Gold Star
U.S.S. Snapper	Navy Cross	One Silver Star
U.S.S. Stingray	Navy Cross	Legion of Merit...Army D.U.B.
U.S.S. Drum	Navy Cross	Two Silver Stars...Two Gold Stars
U.S.S. Flying Fish	Navy Cross	Three Silver Stars...Two Gold Stars
U.S.S. Finback	Navy Cross	One Silver Star...Two Gold Stars...One Bronze Star
U.S.S. Haddock	Navy Cross	Presidential Unit Citation...Two Silver Stars...Four Gold Stars...One Bronze Star
U.S.S. Halibut	Navy Cross	Two Silver Stars...One Gold Star
*U.S.S. Herring	Navy Cross	Legion of Merit
U.S.S. Kingfish	Navy Cross	Three Silver Stars...Two Gold Stars
U.S.S. Shad	Navy Cross	One Silver Star
*U.S.S. Grayling	Navy Cross	One Silver Star
*U.S.S. Grenadier	Navy Cross	One Silver Star...One Gold Star
*U.S.S. Gudgeon	Navy Cross	Presidential Unit Citation
U.S.S. Seahorse	Navy Cross	Presidential Unit Citation
*U.S.S. Tang	Navy Cross	Presidential Unit Citation
U.S.S. Apogon	Navy Cross	One Silver Star
U.S.S. Aspro	Navy Cross	Legion of Merit...One Silver Star...One Bronze Star
U.S.S. Batfish	Navy Cross	Three Silver Stars
U.S.S. Archerfish	Navy Cross	One Silver Star
U.S.S. Burfish		Legion of Merit
U.S.S. Sandlance	Navy Cross	Presidential Unit Citation...One Gold Star...One Bronze Star
U.S.S. Picuda	Navy Cross	One Silver Star...One Gold Star
U.S.S. Pampanito	Navy Cross	
U.S.S. Parche	Navy Cross	One Silver Star...Congressional Medal of Honor Award
U.S.S. Bang	Navy Cross	Two Gold Stars
U.S.S. Pintado	Navy Cross	
U.S.S. Plaice	Navy Cross	Two Silver Stars
U.S.S. Sterlet	Navy Cross	One Silver Star
U.S.S. Queenfish	Navy Cross	
U.S.S. Redfish	Navy Cross	One Gold Star
U.S.S. Burfish		Legion of Merit
U.S.S. Pipefish		One Bronze Star
U.S.S. Piranha		One Bronze Star
U.S.S. Ronquil		One Bronze Star

*Reported missing and presumed lost.

G-1121

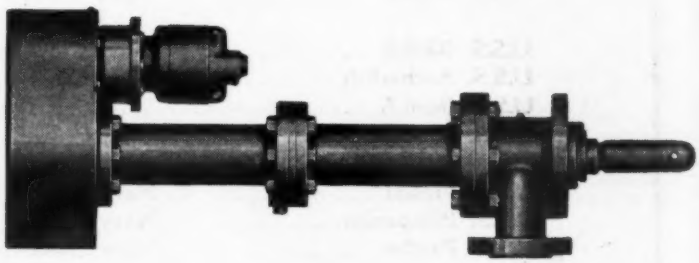
ELLIOTT COMPANY
ELECTRIC POWER DEPARTMENT
RIDGWAY, PA.
DISTRICT OFFICES IN PRINCIPAL CITIES

LOWER OPERATING COSTS

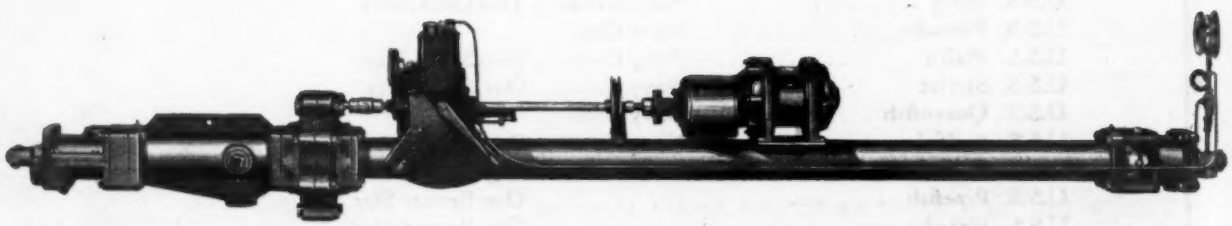
BETTER BOILER CLEANING

Diamond Program panel controls both fixed and retracting blowers (on boiler, superheater, economizer and air heater). Any desired number of groups can be had when system is designed, but panel shows three groups. Entire soot blowing system is operated automatically in proper sequence and at correct speed by simply pushing "start" button. Any group can be operated independently by simply throwing a switch on control panel.

Diamond "Air Puff" Soot Blower having element permanently installed inside the setting. Compressed air for cleaning is discharged from nozzles in a series of short puffs with substantial pauses between which permits use of a much smaller compressor. Air operation automatically rotates element to new position during each puff. Designed with large valve and large air passages to minimize pressure drop.



Diamond Model IF Retracting Soot Blower (at right) uses compressed air as the cleaning medium and is electrically operated.



Diamond "Telescopic" Soot Blower uses compressed air (or steam) as the cleaning medium and is electrically operated as shown; air operation also available.

RESULT FROM

DIAMOND

AUTOMATIC SEQUENTIAL SOOT BLOWING with AIR

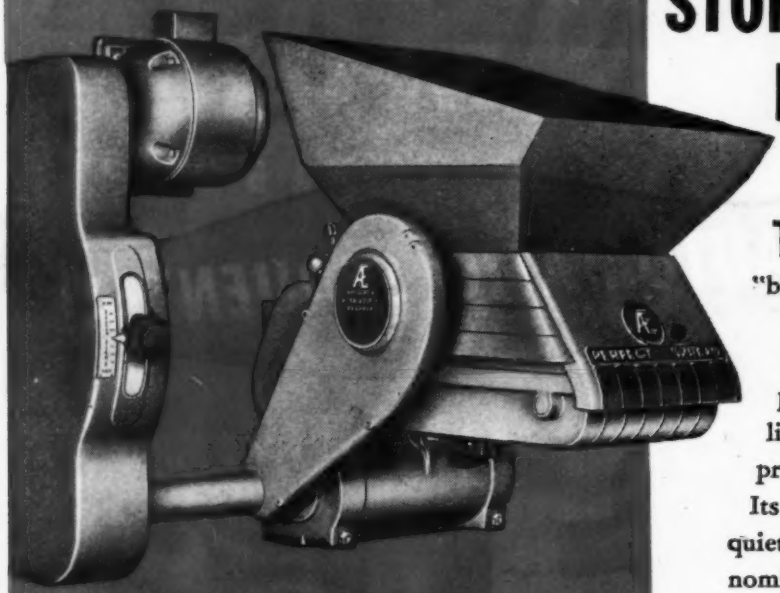
Soot and slag removal with compressed air instead of steam has a number of important advantages that make for lower operating costs as well as better boiler cleaning. Air eliminates the expense of boiler feed-water makeup, and saves energy from the coal pile. Air provides a dryer medium which is particularly desirable for surfaces operating near the dew point. Air is a more effective medium for slag removal because of its greater density and lower temperature. Air requires less blower maintenance on the basis of experience on installations in service since 1940. Air requires no piping insulation. Air permits better control of fly ash flow and grain loading of gas to dust collectors or to atmosphere. Air, when introduced intermittently instead of continuously, eliminates upset operating conditions during soot blowing period.

Other important advantages that are common to all Diamond Automatic Sequential Soot Blower Systems (steam as well as air) are a saving in labor and the elimination of the "human element" which assures that all blowers are operated in proper sequence and at correct blowing speed every time they are operated. Blowers can be either electrically or air operated and controlled —or a combination of both. System can be remotely operated from boiler control board or most convenient location.

Write for further information regarding Diamond Automatic Sequential Air Soot Blowing Systems that have been giving very satisfactory service on boilers as large as 900,000 lb/hr since 1940.

SPECIALTY CORP. Detroit 31, Mich.

DIAMOND SPECIALTY LTD. • Windsor, Ontario



What STOKER STREAMLINING MEANS TO YOU

The days when boiler rooms were noisy "black holes" are past, thanks largely to progress in fuel firing equipment like the Æ Perfect Spread Stoker. This modern, completely automatic stoker is not only streamlined in appearance, but "streamlined" in principle, design and operation.

Its compact, fully-protected mechanism runs quietly and steadily, without clogging. It economically burns all kinds and grades of solid fuel, including by-products and refuse . . . with consistently thorough combustion at a low operating cost.

In plants using steam for power, heating or processing, the Æ Perfect Spread Stoker assures important yearly savings. Be sure to *get the facts* that may favorably affect your whole future operation. Write for this new Bulletin, today!

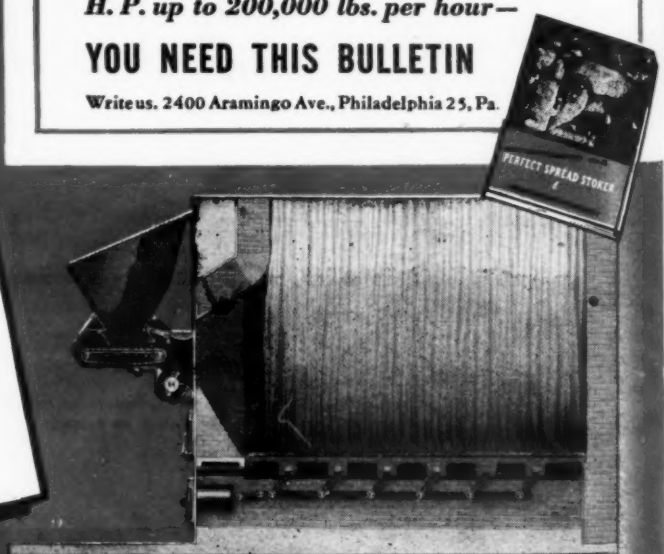
STREAMLINED—UNDER COVER—QUIET!

The all-enclosed, protected mechanism includes automatic, variable-speed feeder with non-clog safety feature and is accessible without tools for inspection or adjustment by merely lifting cover. Simplified construction, water cooling at vital points, and many other features add up to unusually quiet, efficient operation.

If Your Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2400 Aramingo Ave., Philadelphia 25, Pa.



Æ PERFECT SPREAD STOKER

Other Æ Products: Æ Taylor Stokers, Le-Bel Boilers, Marine Deck Auxiliaries, Auto-Flow Feed Pumps, Diamond Face Grinders

AMERICAN ENGINEERING COMPANY

Subsidiaries: COCHRANE CORPORATION, Philadelphia, FARADAY ELECTRIC CORPORATION, Adrian, Mich.

PHILADELPHIA 25, PENNSYLVANIA

15 MINUTES

MAY ALTER YOUR POWER OUTLOOK!

The few minutes it will take you to examine the new booklet describing the Improved Æ Taylor Stoker may mean much to you and your company. In it you'll see new features that add years of progress to the design, operation and performance of this time-tested stoker.

You'll see how simplified unit construction reduces installation costs; how the unique continuous ash discharge is automatically timed; how slag formation is minimized; how "finger-tip" ash discharge becomes a reality; how precision feed and better air flow maintain uniformly thorough combustion; how fewer moving, longer wearing parts contribute to lowered steam costs.

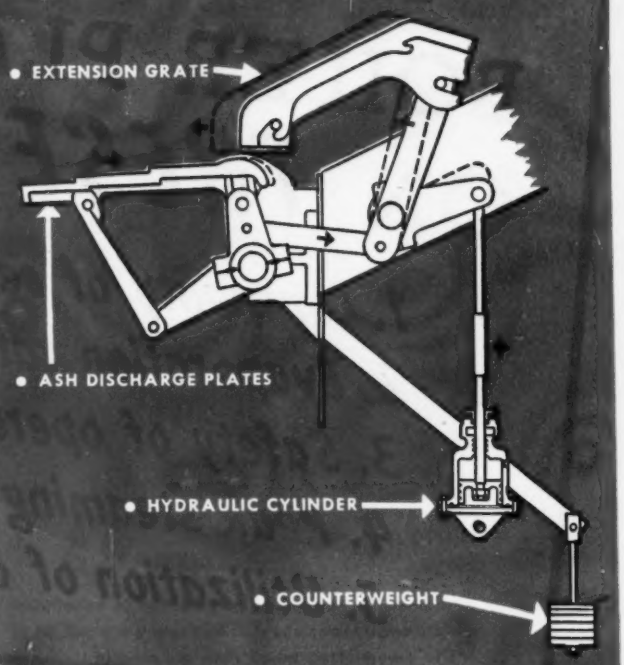
You'll see why these improvements in the Taylor Stoker logically provide even greater efficiencies and economies than previously. Before you decide on *any* equipment take time to send for and study this booklet. It will be time well spent.

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

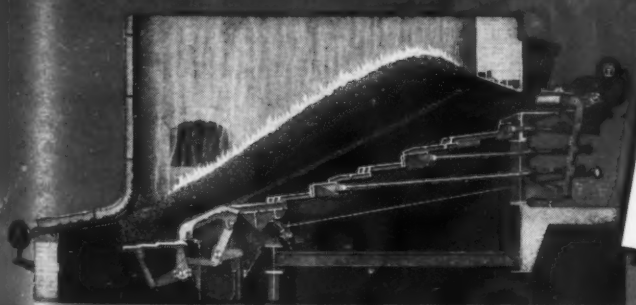
Write us. 2400 Aramingo Ave., Philadelphia 25, Pa.

ANOTHER IMPROVED FEATURE OF THE TYPE "R" TAYLOR STOKER



Hydraulically driven independent of the main stoker drive, reciprocating discharge plates provide ash movement ALL-THE-WAY TO THE END OF THE STOKER.

Rearward and slightly upward movement of overfeed section effectively moves ash onto the discharge plates. When overfeed section completes rearward travel, continuation of ash movement to point of discharge is assured by rearward travel of discharge plates.



Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

Other Æ Products: Æ-Perfect Spread Stoker, La-Mont Boilers, Marine Deck Auxiliaries, Bole Steam Feed Pumps, Diamond Face Extractors

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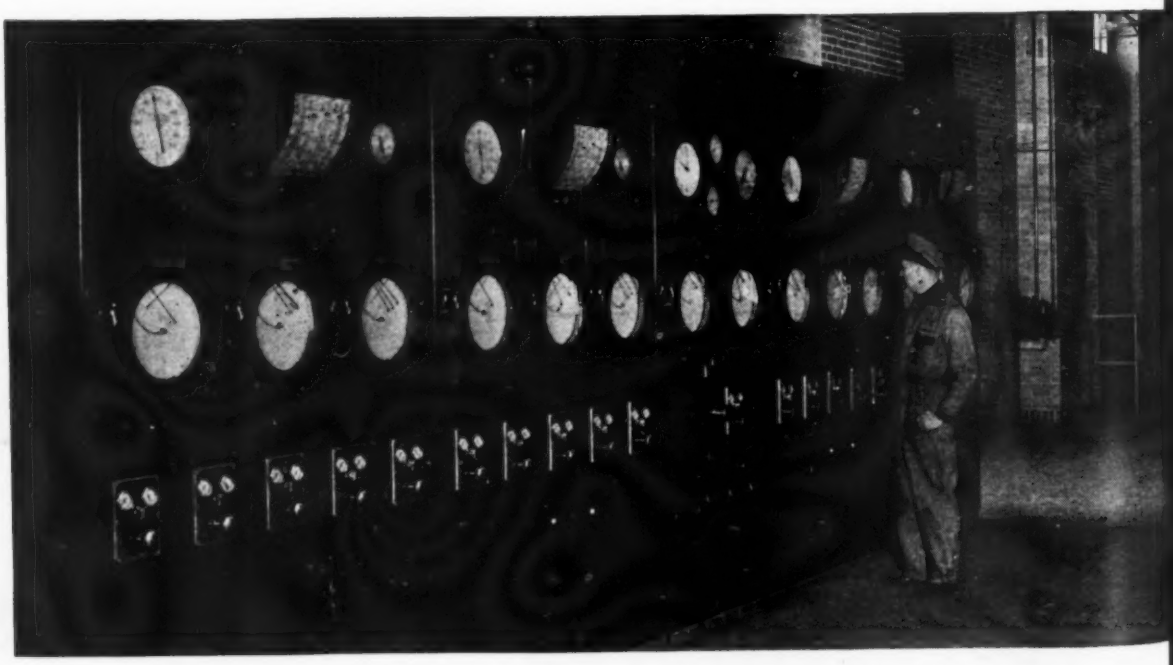
PHILADELPHIA 25, PENNSYLVANIA

HOW DOES YOUR BOILER PLANT RATE ON *THESE* POINTS?

1. Continuity of service.
2. Evaporation ratio.
3. Safety of operation.
4. Peak steaming capacity.
5. Utilization of available manpower.



This Bailey Boiler Control Panel continuously maintains Optimum Performance in a central heating plant.

BAILEY METER CONTROL

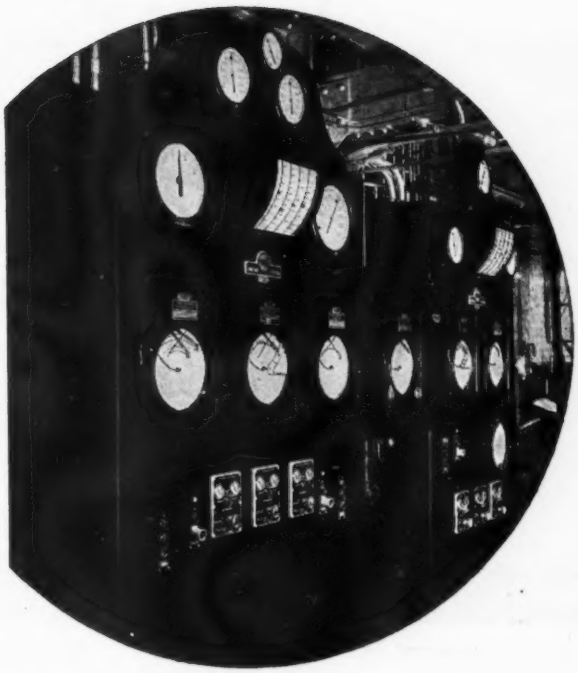
BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

✱ Optimum performance may be secured on all these counts by applying engineered instrumentation in the form of Bailey Boiler Meters and Control.

Bailey Boiler Meters and Control are specified and applied to the individual requirements of each plant. Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation, and final adjustment on the job.

Engineering work in the user's plant is done by Bailey Field Engineers, who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has a background of combustion engineering "know-how" which has been accumulated through years of service. He has at his command the results of thousands of tests on boiler installations covering a wide range of fuels, furnaces, and fuel burning equipment. He has more to offer than meters and controllers. He is primarily interested in helping you to secure optimum operating conditions in your plant. G-24



Installation of Bailey Boiler Meters and Boiler Control in an Eastern paper mill. This equipment automatically functions to maintain daily boiler performance at the same high standards obtained during boiler tests.

BAILEY METER COMPANY
1036 IVANHOE ROAD, CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

The Complete Combustion Control System

TROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

FLUE DUST takes a "detour"

HERE IS THE S.A.I.D. PRINCIPLE

Unique Sturtevant "reverse flow" arrangement of inlet boxes and vanes utilizes the weight of flying ash particles to separate them from the flue gas. A portion of the gas carrying the concentrated ash is carried to an auxiliary collector for disposal—clean gas being returned to the system.

HERE ARE S.A.I.D. ADVANTAGES

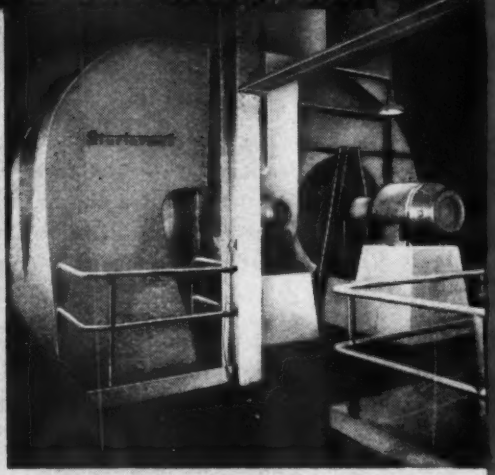
1. Fan wear and maintenance minimized because fly ash separation occurs ahead of the fan wheel.
2. Space economy often allows installation where no provision was made for collectors.
3. Additional horsepower is generally less than required for independent collectors.
4. Weight savings over independent collectors eliminate the need for increased structural support.
5. Cost of apparatus, installation, insulation and ductwork is held to a minimum.

HERE ARE TYPICAL USERS

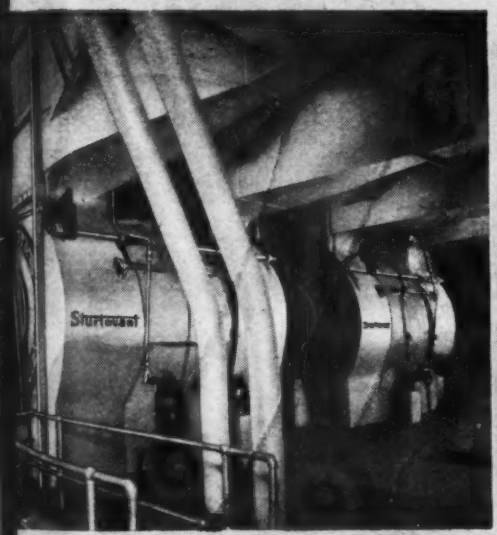
American Steel Foundry	E. Chicago, Ind.
Appalachian Electric Power Co.	Glen Lyn Station
Bigelow Sanford Carpet Co.	Amsterdam, N.Y.
Bigler Chemical Corp.	Philadelphia, Pa.
Defense Plant Corporation	Chester, W. Va.
Diamond Magnesium Co.	Plainville, Ohio
Fitchburg Gas & Electric Light Co.	Fitchburg, Mass.
Indiana & Michigan Electric Co.	Twin Branch Sta.
Virginia Electric Light & Power Co.	Chesterfield Sta.
Taunton Municipal Lighting Plant	Taunton, Mass.

HERE IS HOW S.A.I.D. LOOKS INSTALLED

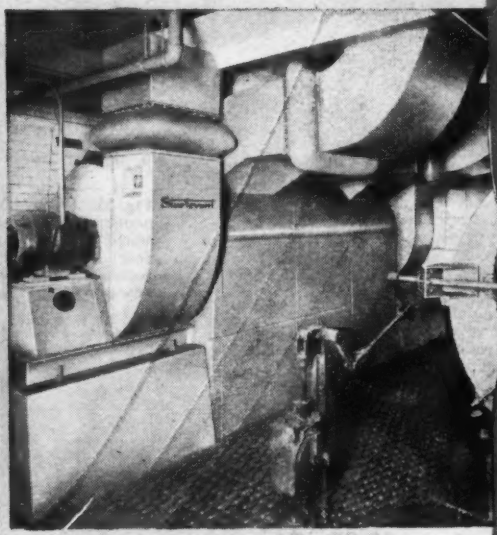
Sturtevant S.A.I.D. System at Appalachian Power Co., Cabin Creek, W. Va., showing Induced Draft Fan at left, and collector and auxiliary fan at right.



New Bedford Gas and Electric Co., New Bedford, Mass., showing S.A.I.D. Equipment. Auxiliary fan and collector in the center are partly hidden by the beam.



Two S.A.I.D. Fans installed at Twin Branch plant of the Indiana and Michigan Electric Company.



Close up of secondary fan and collector at Taunton Municipal Lighting Plant, Taunton, Mass. Forced Draft Fan is at right and Induced Draft Fan is on floor above.

AIR CONDITIONING

DRYING

HEATING

VENTILATING

MECHANICAL DRAFT

DUST AND FUME CONTROL

Sturtevant tackled the fly ash problem in the right way—separating fly ash from the flue gas *before* it hits the fan wheel.

RESULT—The S.A.I.D. system that minimizes your flue dust problem—safeguarding and greatly extending the life of induced draft wheels. Savings in expense due to maintenance, repairs, replacement and fan outages are realized—often far in excess of the initial cost *within the first year.* Scores of the operators of the country's foremost power plant operators are obtaining these savings. Why not talk it over with one of our Power Apparatus specialists?

B. F. STURTEVANT COMPANY
Hyde Park Boston 36, Mass.

Sturtevant
REG. U. S. PAT. OFF.
Puts Air to Work

"Tomorrow

Because, for almost a century, Powell Engineering has been anticipating the flow control requirements of products and processes still in the laboratory stage, Powell was ready to meet—and has met—every new demand imposed by war. Today we can justifiably say "there's a Powell Valve for every *known* requirement of industry."

But "tomorrow is another day" and it will bring new problems in flow control. Powell, as always, will be ready to solve them.

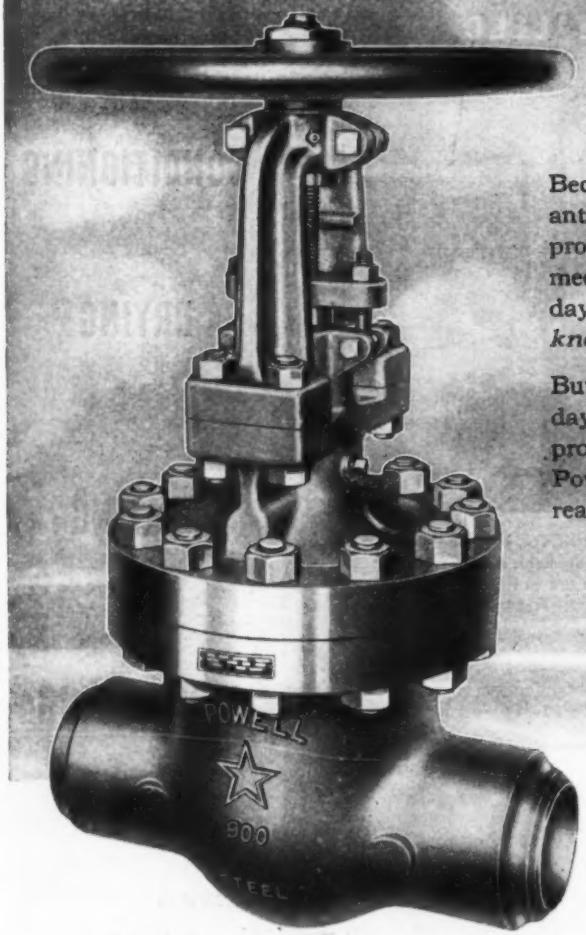


Fig. 9003 W. E.—Class 900-pound Cast Steel Gate Valve. Welding ends, outside screw rising stem, bolted flanged yoke, renewable seat rings and taper wedge solid disc.

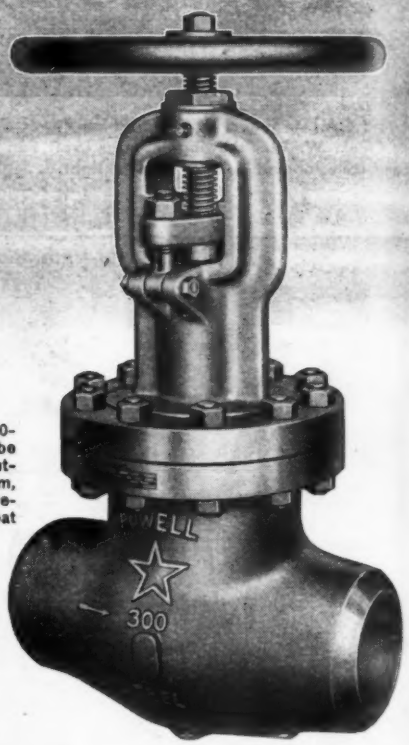


Fig. 3031 W. E.—Class 300-pound Cast Steel Globe Valve. Welding ends, outside screw rising stem, bolted flanged yoke, renewable plug disc and seat ring.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

is another day"

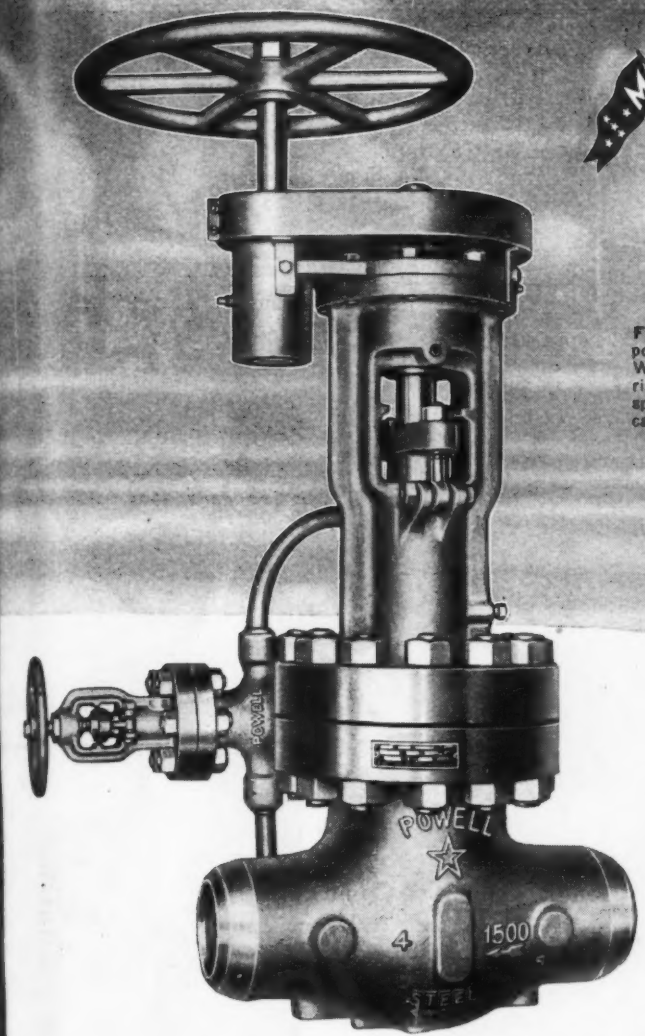


Fig. 9013 W. E. — Class 900-pound Cast Steel Gate Valve. Welding ends, outside screw rising stem, welded bonnet, special by-pass and inspection cap. Bevel gear operated.

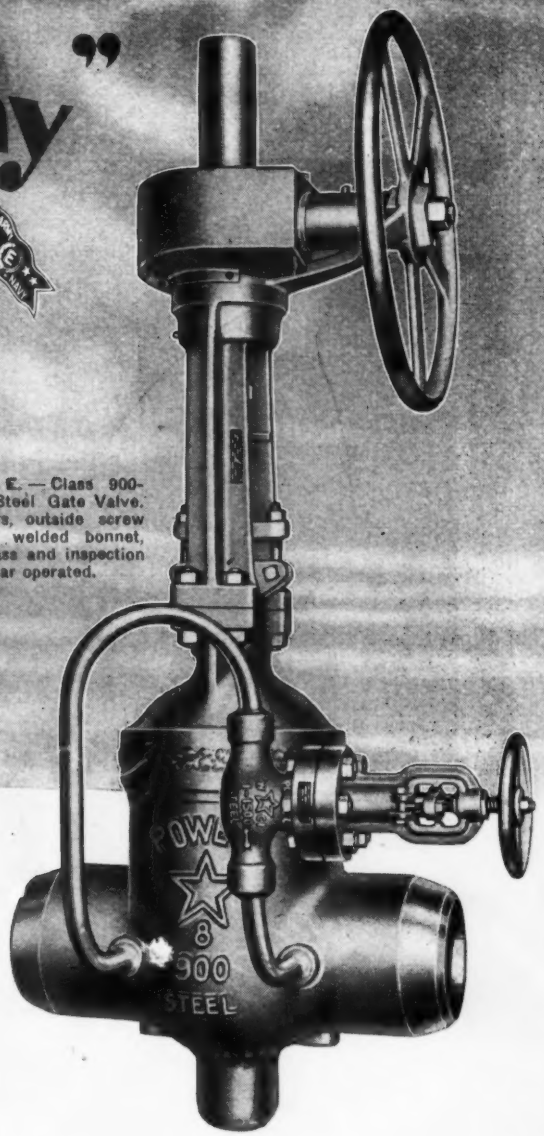
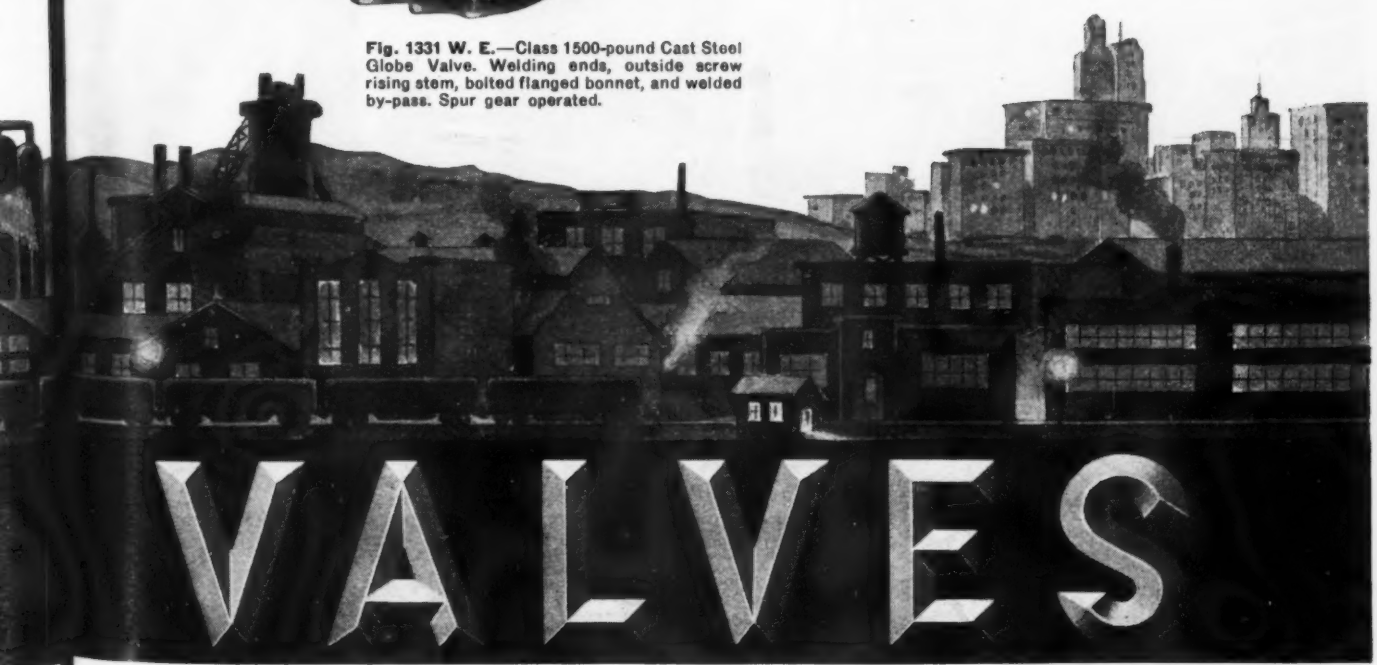
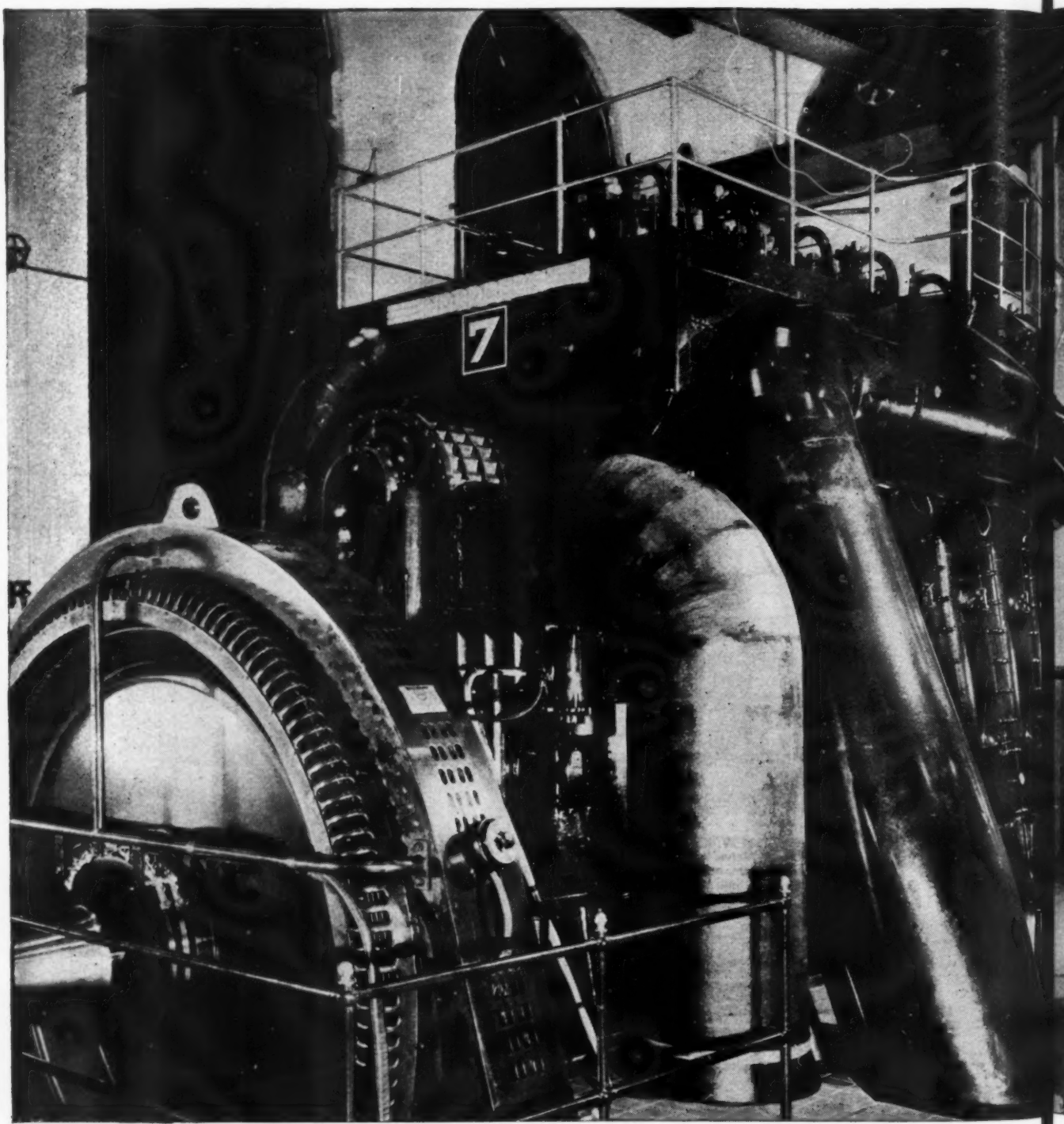


Fig. 1331 W. E.—Class 1500-pound Cast Steel Globe Valve. Welding ends, outside screw rising stem, bolted flanged bonnet, and welded by-pass. Spur gear operated.



VALVES

DIESEL MAINTENANCE



TUNE IN THE
TEXACO STAR
THEATRE WITH
JAMES MELTON
*EVERY SUNDAY NIGHT
—CBS

TEXACO
REG. T. M.

TEXACO

GREATLY REDUCED

WHEN YOU USE lubricants that:

- ★ keep valves active
- ★ assure clear ports
- ★ provide complete piston seal
- ★ afford greater fuel economy
- ★ are designed for each type of Diesel

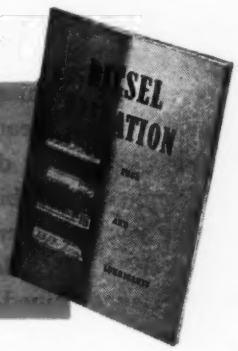
Texaco Ursa Oils bring you all these benefits. They are products born of The Texas Company's years of leadership in this field—lubricants specially developed in a complete line to meet the requirements of every type of Diesel engine. Records show they definitely increase operating efficiency, greatly reduce service and maintenance costs in stationary, mobile and marine installations.

Experience of operators everywhere has proved that use of *Texaco Ursa Oils* prevents scuffing, ring sticking, sludge and corrosion; increases life of rings, pistons, liners and bearings. Because of these benefits—

More stationary Diesel hp. in the U. S. is lubricated with Texaco than with any other brand.

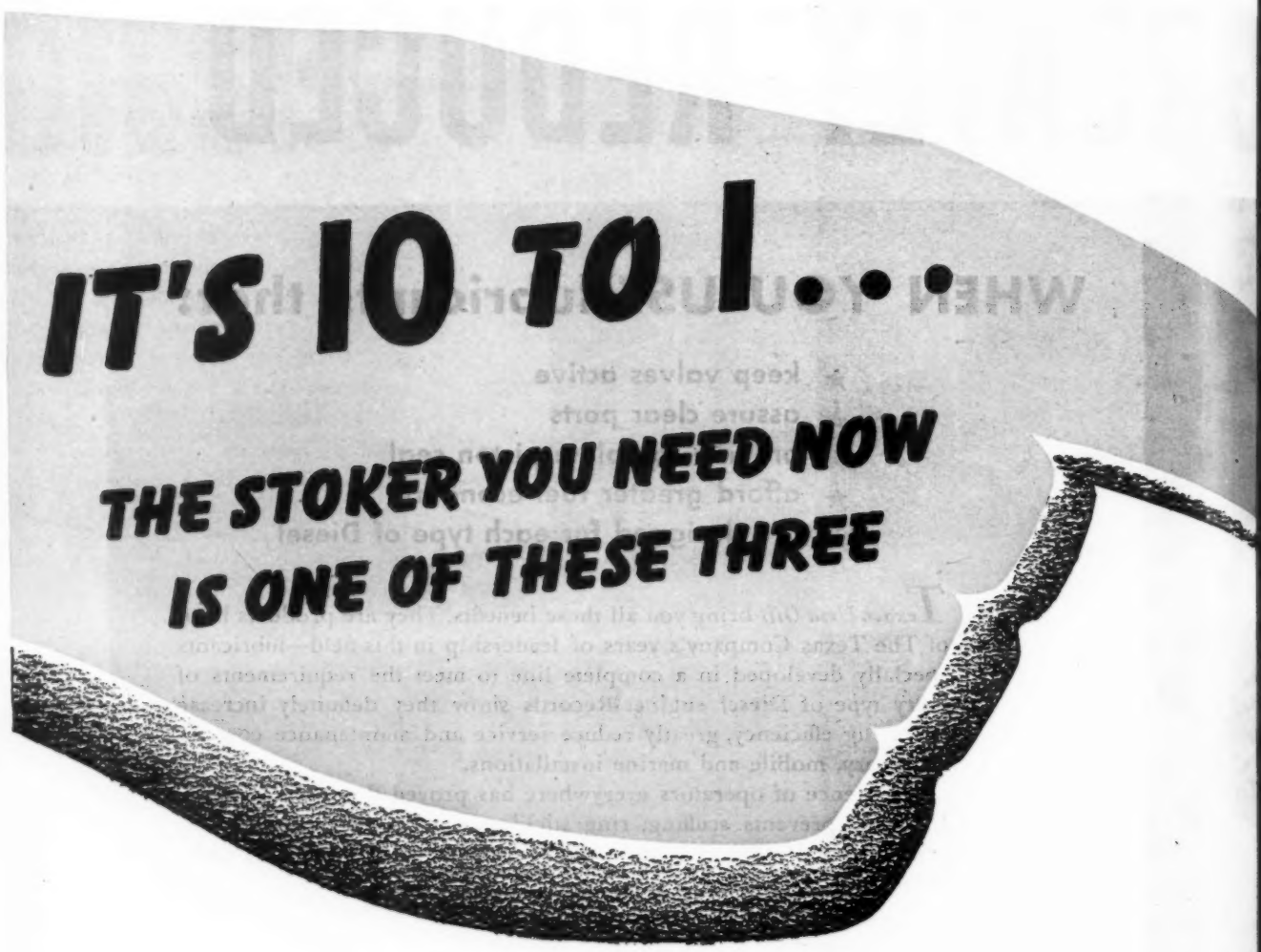
A Texaco Lubrication Engineer, specializing in Diesel lubrication, is available to recommend the most suitable grade and type of *Texaco Ursa Oil* for your engine. Get in touch with the nearest of more than 2300 Texaco distributing plants in the 48 States, or write to The Texas Company, 135 East 42nd Street, New York 17, N. Y.

FREE: "Diesel Operation"—fully illustrated, 112-page book of facts and figures. Shows simply and clearly relation of fuel and lubricants to operating efficiency of Diesel engines. Write for your copy today.



Lubricants and Fuels

FOR ALL DIESEL ENGINES



HERE are three stoker designs — each developed to meet a different combination of requirements — which have demonstrated through actual survey, their complete suitability for 90% of all installations covered by C-E contracts of recent years.

These three simplify for you the problem of stoker selection to one of merely determining which type is the answer to your conditions of steam load, boiler design, and available fuels. With that done, you can be sure of reliable performance, durability, and low maintenance by entrusting your requirements to C-E. For embodied in each of these three designs are all the "know how" and experience gained from the installation of over 18,000 stokers of every type, above residence size, to serve approximately 5,000,000 rated boiler horse power.

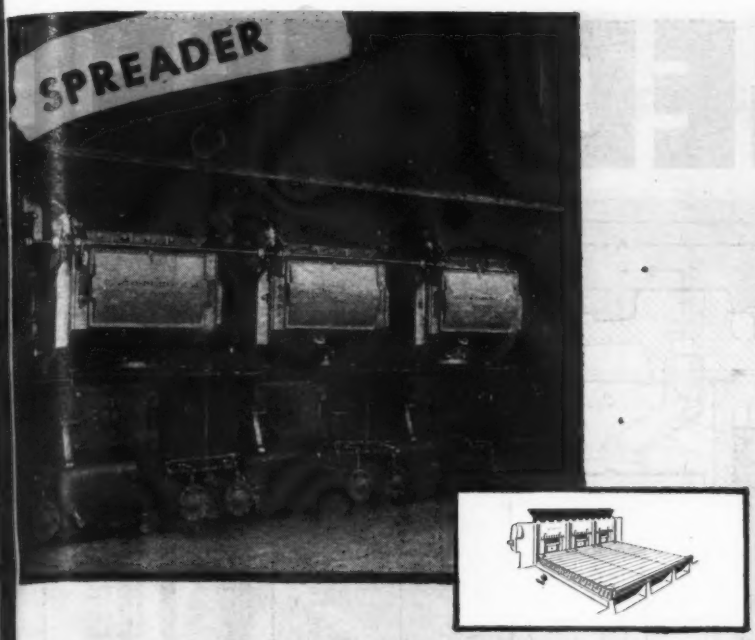
Comprehensive as these three types are, the C-E line includes other designs which round out the most complete line of stokers offered by anybody anywhere. So if your installation falls outside the 90% and within the remaining 10%, you will certainly find the answer to your needs among modern C-E designs of Multiple Retort, Travelling Grate, and Chain Grate Stokers.

Now is none too soon to plan for your new post-war installation or needed replacements. A C-E engineer will be glad to discuss your problem with you. A-829

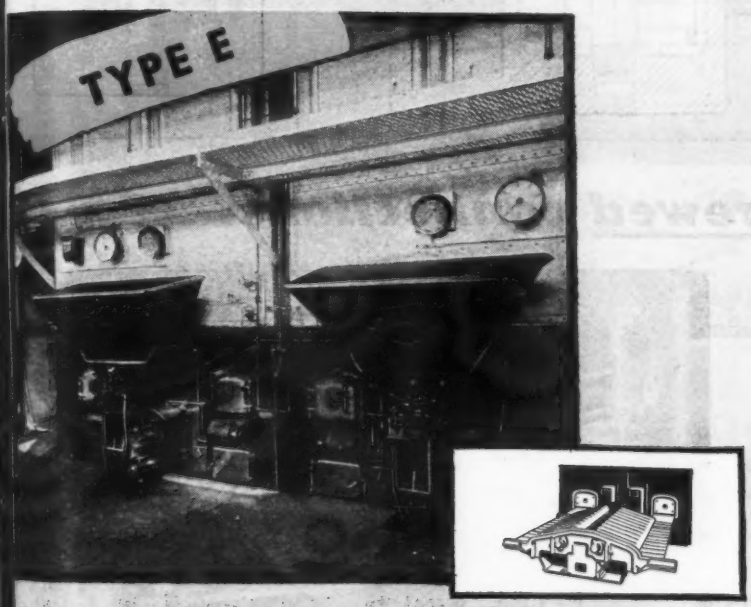
COMBUSTION C-E ENGINEERING

200 MADISON AVENUE · NEW YORK 16, N. Y.

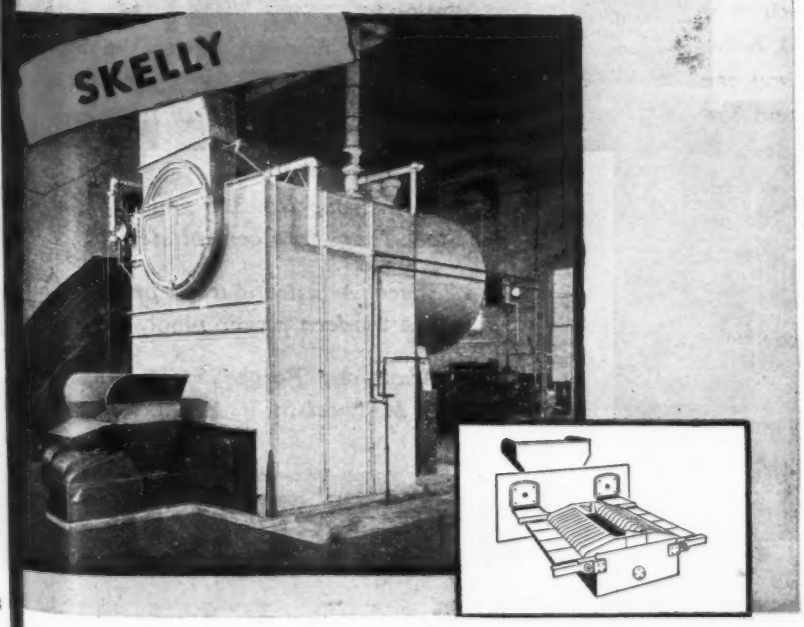
C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



Approximate Application Range — 150 boiler hp to largest units suitable for stoker firing. A simple, rugged stoker designed to burn a wider variety of fuels than any other type of mechanical firing. Hopper, feeding and distributing mechanism, variable-speed drive and motor are combined in a compact unit. Rotating spreader blades feed coal into the furnace in crisscrossing streams which assure uniform distribution. Fines are burned in suspension and the rest of the coal is burned on a grate — stationary or dumping type. Grate surface is zoned for regulating air admission and to facilitate cleaning.

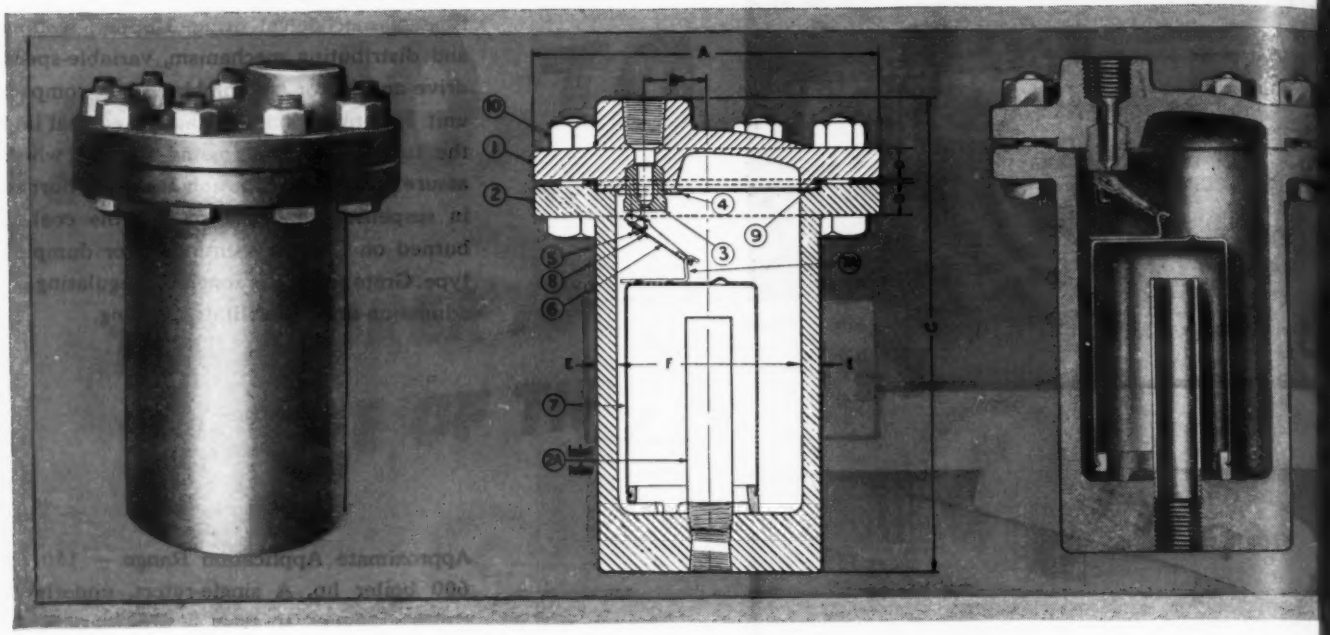


Approximate Application Range — 150 to 600 boiler hp. A single-retort, underfeed stoker designed to burn a wide variety of bituminous coals. Ram feed is supplemented by a reciprocating sliding bottom. Grate surface consists of hollow, air-cooled grate bars, alternately fixed and moving, to condition the fuel bed and assure its steady movement toward the dump trays. Air supply under zoned control with provision for introducing air over the fire. Steam or hydraulic drive.



Approximate Application Range — 20 to 200 boiler hp. A compact, self-contained unit offering all the advantages of underfeed firing. Moving grate bars assure lateral distribution of fuel and maintain a clean porous fire. Cantilever dump grates of non-avalanching type simplify ash removal. Integral forced-draft fan, with vortex inlet control, permits positive regulation of air-coal ratio. Sixteen rates of coal feed through variable-speed transmission. Automatic control is standard equipment. Timken bearing equipped. Alemite lubrication throughout.

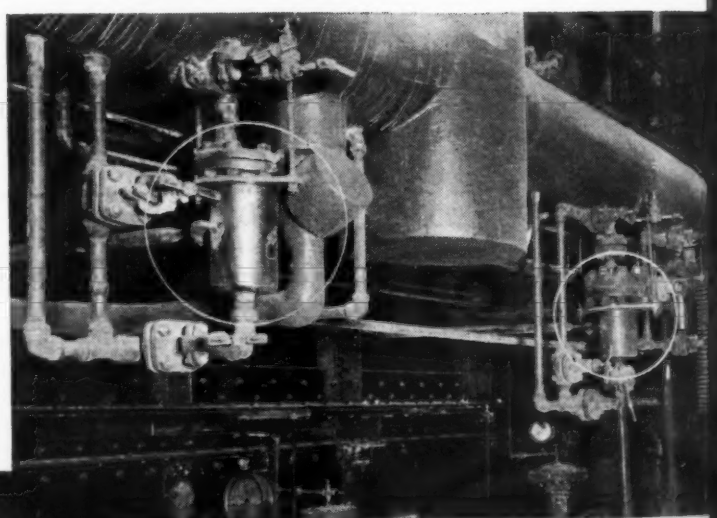
FORGED STEEL

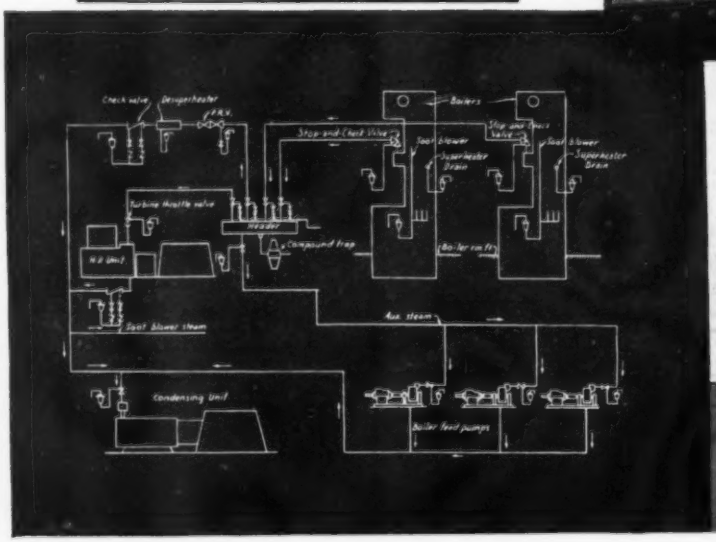


. . . with screwed connections

LIST OF MATERIAL
(Traps No. 312-515)

Part No.	Name of Part	Material
1 & 2	Cap and Body	Die Forgings (S.A.E. 1030) 79,000 lbs. Tensile Strength
2A	Inlet Tube	Wrought Iron
3	Valve Seat	Chrome Steel (Heat Treated)
4	Guide Pin Assembly	18-8 Stainless Steel
5	Valve	Chrome Steel (Heat Treated)
6	Lever	18-8 Stainless Steel
7	Bucket	18-8 Stainless Steel Cap & Tube—Cast Iron Bottom Weight
7A	Bucket Hook	18-8 Stainless Steel
8	Valve Retainer	18-8 Stainless Steel
9	Gasket	Compressed Graphited Asbestos
10	Bolt & Nut Set	Bolts Supertemp Steel, 149,000 lbs. Tensile. nuts hex. semi-finish (S.A.E. 1030)





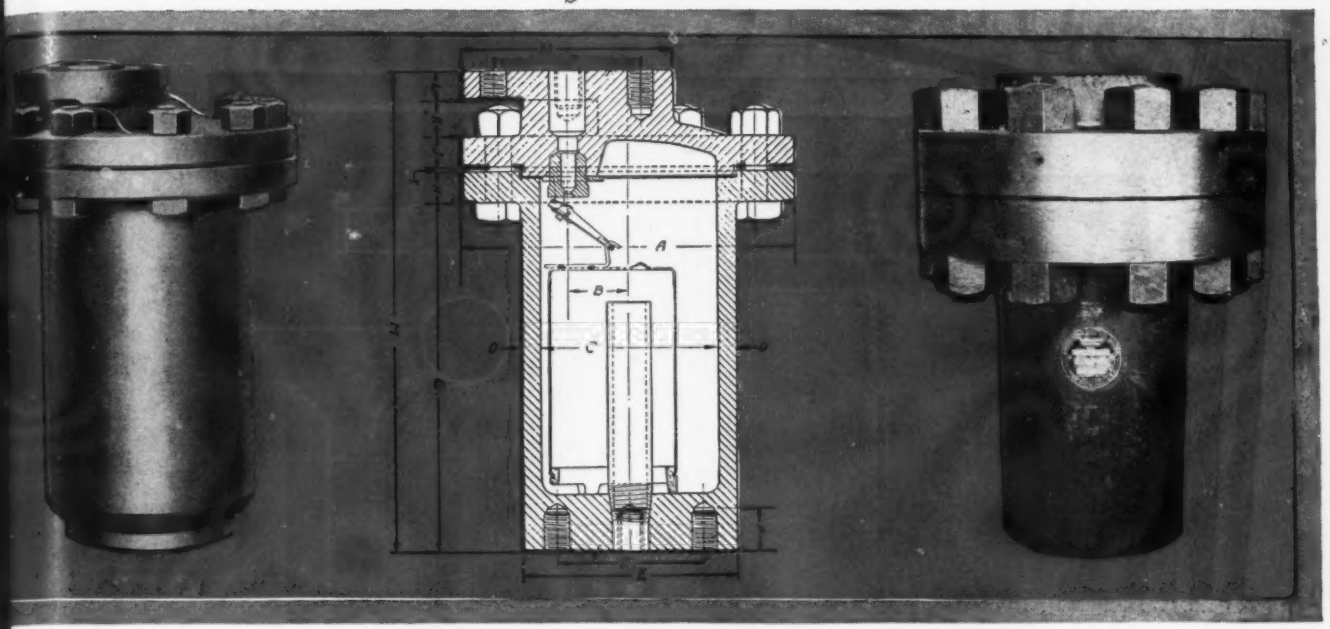
Above — Armstrong No. 315 and 515 Forged Steel Traps in a central station.

Left — Typical Armstrong trap applications in a modern power plant.

Right — Armstrong Forged Steel Traps at a Midwest utility plant.

ARMSTRONG

TRAPS for pressures up to 2400 lbs.



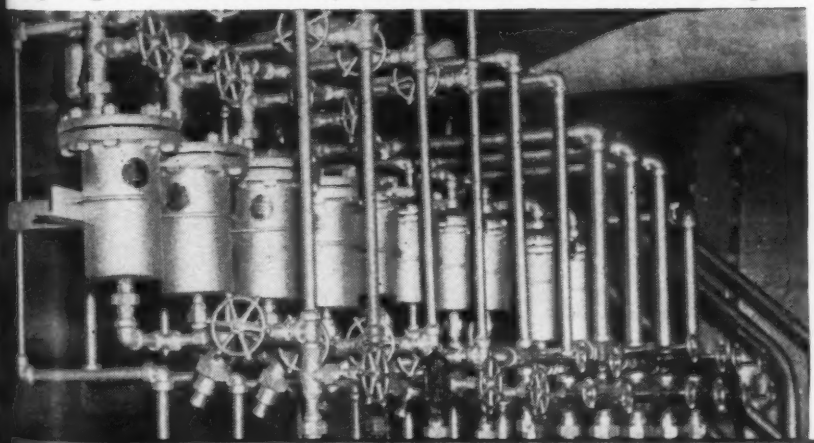
. . . with flanged connections

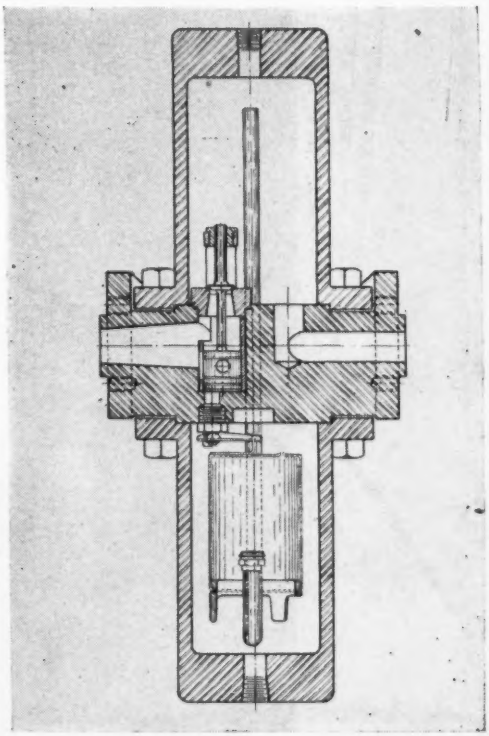
DEVELOPMENT over a period of years of the Armstrong line of forged steel steam traps has gone along with two trends in modern power plant design:

1. Elimination of all cast iron fittings.
2. Completely automatic condensate drainage.

Here are traps engineers like. Simple — dependable. High quality materials. Well designed and well built. A size and type for every application. Backed by nearly 40 years' experience and an unconditional guarantee.

Ask for a copy of the Armstrong STEAM TRAP BOOK, a helpful guide to the selection, installation and maintenance of traps.





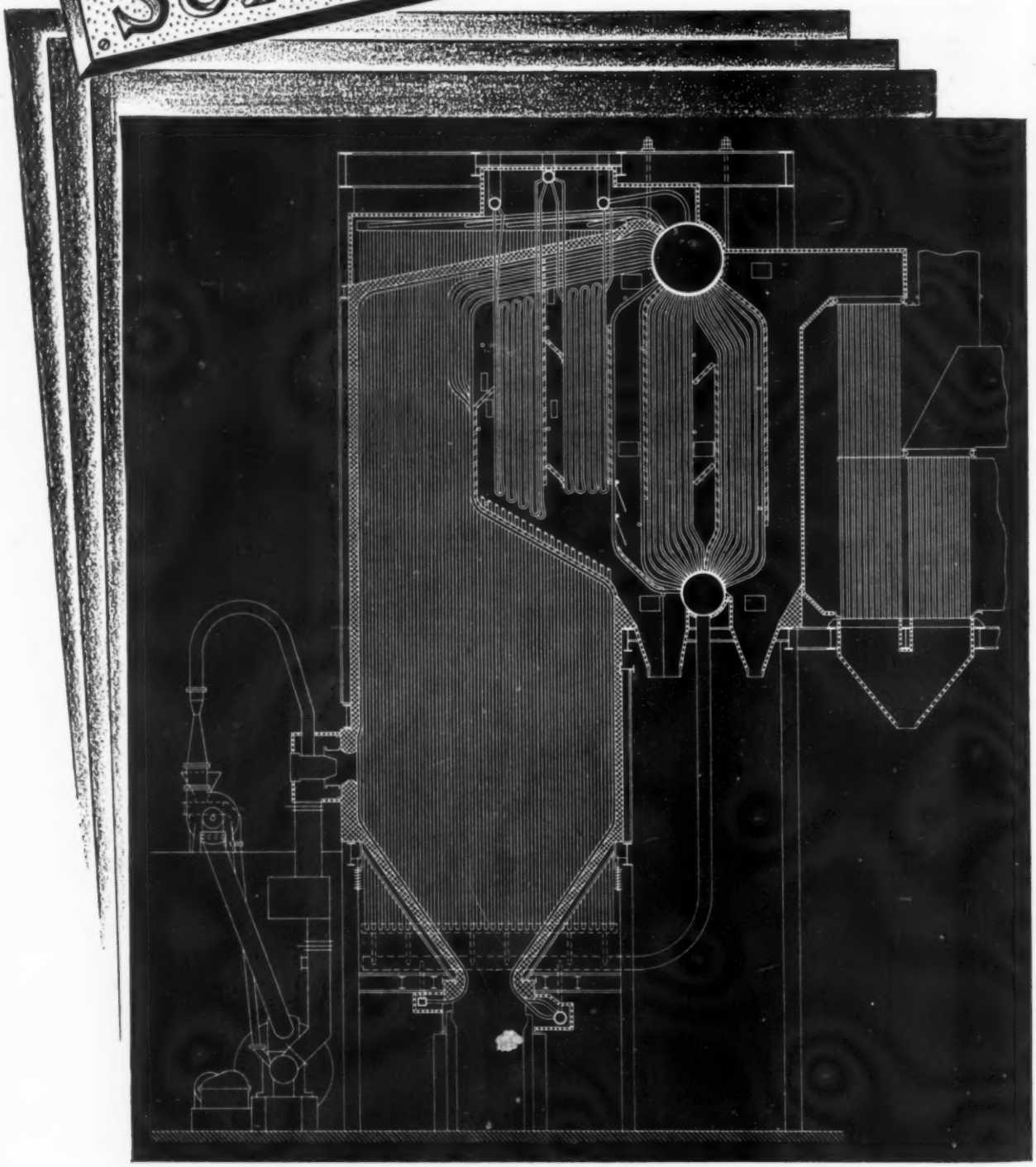
Armstrong Compound Trap

For large amounts of condensate. Capacities to 240,000 lbs. of condensate per hour at pressures to 600 psi. For draining steam purifiers and separators, flash tanks, continuous blow down systems, etc.

MACHINE WORKS

812 Maple Street
Three Rivers, Michigan

SUPERIOR STEAM



Steam Generators for New Bedford Gas & Edison Light Co. and Staten Island Edison Corp.

FW FOSTER

GENERATOR DESIGN

FOR

New Bedford and *Staten Island*

FOUR new steam generators each designed for 120,000 lb. per hr. at 950 lb. sq. in. and 910°F. final steam temperature.

STEAM GENERATION

Large Central Station steam generator design applied to medium capacity units.

High furnace—long flame travel—cool exit gases—minimum tendency to slag.

Control of final steam temperature from 60% to full load.

Ample circulation head.

Exceptional accessibility of pressure parts.

PULVERIZED FUEL FIRING

Sustained efficiency due to fine pulverization.

Ability to handle low grade, wet coal.

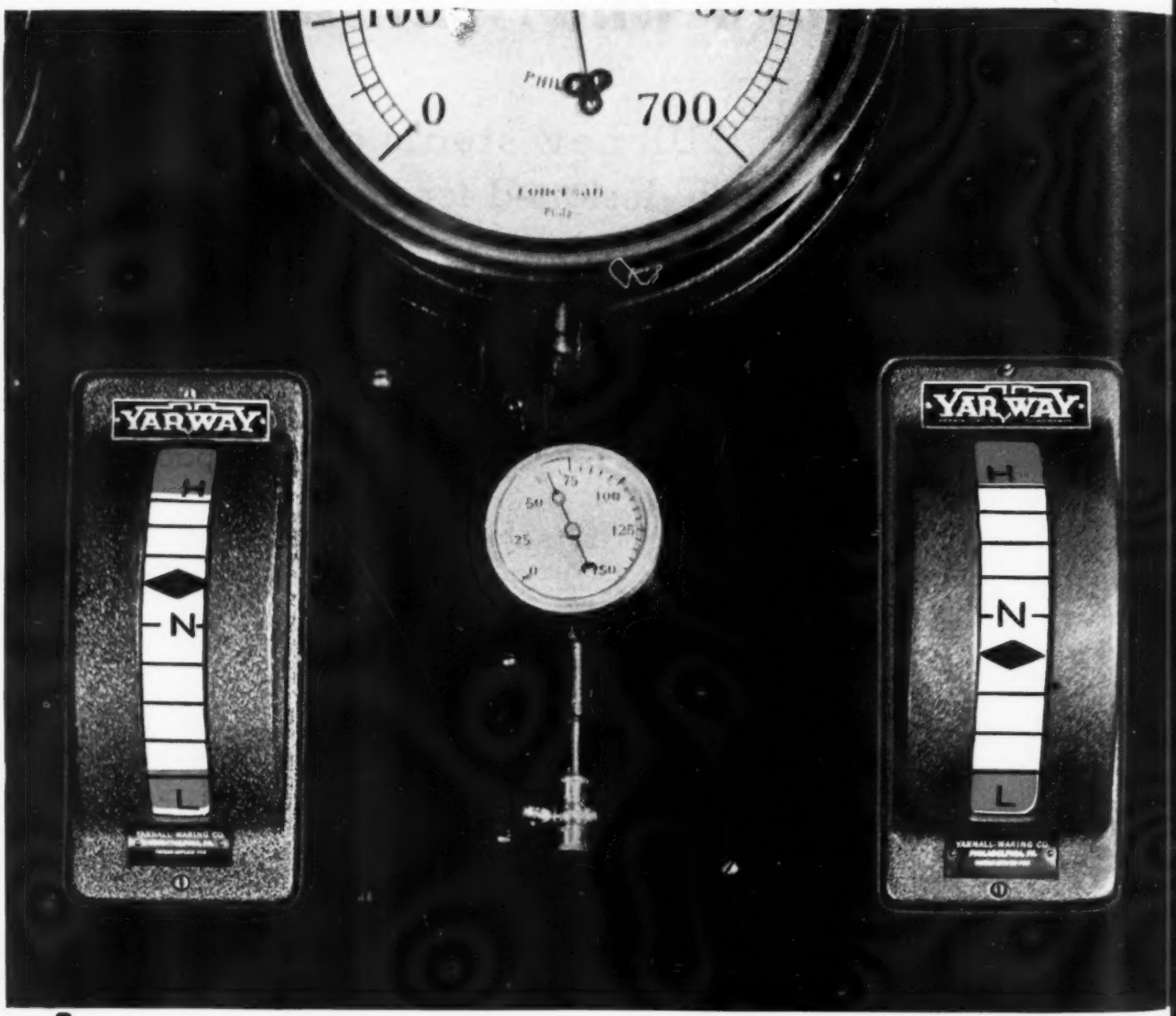
Surplus pulverized fuel always available for sudden increases in load or temporary plugging of coal supply.

FOSTER WHEELER CORPORATION

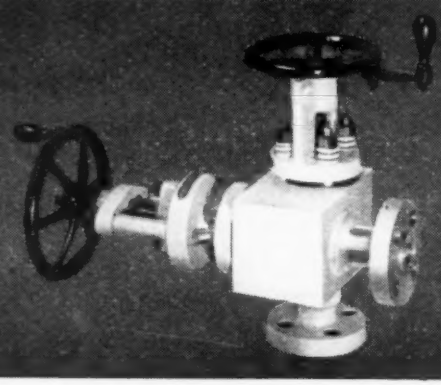
165 BROADWAY • NEW YORK 6, N. Y.

WHEELER

SAFEGUARD



YARWAY SEATLESS TANDEM BLOW-OFF VALVES— standard in over 12,000 plants—for pressures to 600 psi. Famous balanced sliding plunger design with non-clogging, straight-through flow. No seats to score, wear and leak. Described in Catalog B-432.



YARWAY UNIT TANDEM BLOW-OFF VALVES, built for pressures up to 2500 psi. Combining a Hard-Seat blowing valve next to boiler and a Seatless sealing valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or for draining and sealing—in a compact, rugged unit. Ask for Catalog B-432.

YOUR BOILERS

with Yarway

BOILER TRIM

Maximum protection of steam generating units is possible only with the most dependable auxiliaries. For nearly 40 years Yarway has specialized in designing, developing and manufacturing boiler auxiliaries of outstanding merit. Yarway Blow-Off Valves, Water Columns and Gages and Liquid Level Indicators are today regarded as standards in the industry.

Take, for example, the Yarway Remote Liquid Level Indicator shown at left. Introduced publicly only one year ago, this unique instrument met with wide acceptance and approval. Already well over 2000 have been bought for indication of boiler water level, feed heater water level, and superheater pressure differential.

The Remote Liquid Level Indicator answers a long-standing need for a positive, foolproof method of boiler water level indication at eye-level, on the instrument panel or any other convenient location. It is always accurate because it's operated by the boiler water itself—by the pressure differential between a constant head of water and the varying head in the boiler drum. Indicating mechanism is never under pressure. Its action is instant, constant, frictionless. *There are no stuffing boxes.* Mechanism is perfectly balanced on jewelled bearings outside of the pressure chamber.

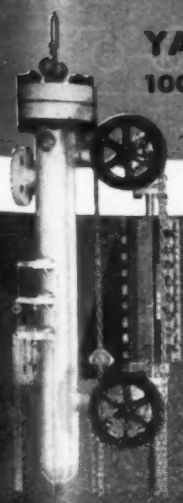
It is easily installed on new or existing equipment as the diagram at right shows. Suitable for all pressures up to 1500 psi. Catalog WG-1820.

YARWAY REMOTE LIQUID LEVEL INDICATOR

Made for Flush Panel Mounting —or Wall Mounting (as shown).

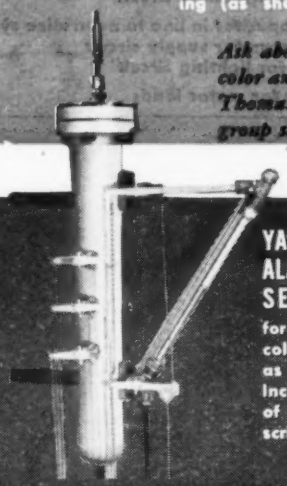
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

Ask about the new Yarway 30-minute color and sound motion picture, Lowell Thomas speaking . . . available for group showings.



YARWAY FLOATLESS HI-LO ALARM WATER COLUMN AND FLAT-GLASS GAGE,

for pressures up to 1500 psi. Alarm mechanism utilizes balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous deviations from normal water level. Pressure-sealed flat glass gage inserts are mica protected and have Patented spring-loaded cover-plates which prevent excessive strain on glass. Ask for Catalog WG-1810.



YARWAY FLOATLESS HI-LO ALARM WATER COLUMN WITH SESURE INCLINED GAGE,

for pressures up to 400 psi. Water column operates on same principle as that described at left. Sesure Inclined Gage gives easier reading of water level from below. Described in Catalog WG-1810.

YARWAY STEAM PLANT EQUIPMENT

12 EASY METHODS OF IMPROVING VOLTAGE ON YOUR PLANT CIRCUITS

HOW TO CORRECT LOW VOLTAGE

Feeder Voltage Condition	Circuit Loading	Power Factor	Correct by means of	See Fig.
Low	Normal	Good	Transformer tap setting	1
			Voltage regulator	2
			Autotransformer	3
High feeder drop	Normal	Good	Voltage regulator	2
			Parallel circuit	4
			Autotransformer	3
High feeder drop	Normal	Low	Shunt capacitors	5
			Voltage regulator	2
High feeder drop	Overload	Low	Shunt capacitors	5
			Shunt capacitor and voltage regulator	6

HOW TO CORRECT HIGH VOLTAGE

Normal drop	Normal	.....	Voltage regulator	2
			Transformer tap setting	1
Normal drop	No load	.....	Voltage regulator	2
			Transformer tap setting	1
Voltage rise	"No load" (except shunt capacitors are on)	Leading at no load	Automatic switching of capacitors	7
			Voltage regulator (if no penalty clause for leading power factor)	6

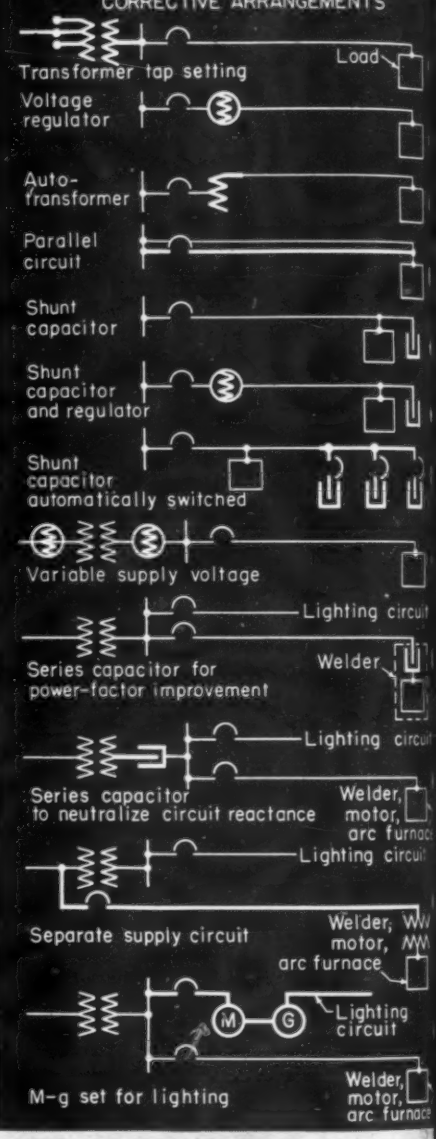
HOW TO CORRECT VARIABLE SUPPLY VOLTAGE

(Use voltage regulator or stabilizer) 8

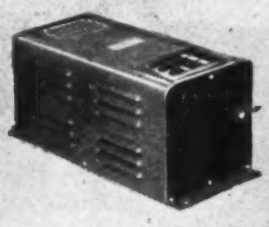
HOW TO CORRECT LIGHTING FLICKER

Load Causing Flicker	Correct by means of	See Fig.
Resistance welders, spot or seam	Series capacitor with welder to reduce demand by power-factor correction	9
	Series capacitor in line to neutralize system reactance	10
	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Flash and resistance welders	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Motor loads, such as: sawmills, rubber mills, grinders	Series capacitor in line to neutralize system reactance	10
	Separate motor supply circuit	11
	M-g set for lighting circuit	12
Arc furnaces	Same as for motor loads	

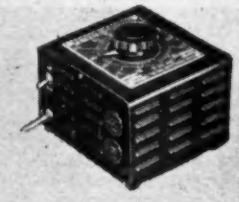
SCHEMATIC DIAGRAMS OF CORRECTIVE ARRANGEMENTS



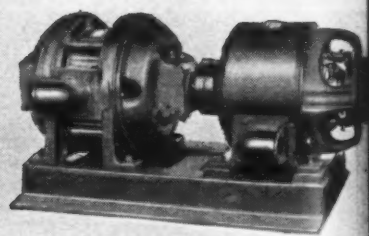
THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB BETTER



Voltage stabilizers—Automatically provide a constant 115-volt supply to a given load on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes. Ask for Leaflet GEA-3634.

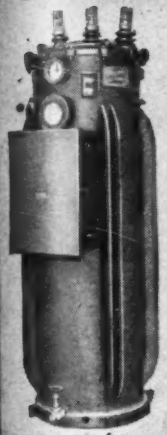


Variable-voltage autotransformer—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factory and laboratory. Described in Leaflet GEA-3635.



Motor-generator sets—Change a-c to d-c. Provide an inexpensive way to supply your lighting circuits independent of your power circuits to avoid lighting flicker. See diagrams 11 and 12. Described in Leaflet GEA-1945 (synchronous type); Leaflet GEA-394 (induction type).

FOR SUCH CIRCUITS WE RECOMMEND THESE AIDS TO BETTER VOLTAGE



Pyranol or oil-filled regulators—Ideal for regulating variable line voltage (see diagram 8), or voltage on plant feeders. Provide 10% regulation raise and lower; automatic operation; 12 to 120 kva, 2400 to 6900 volts. Described in Leaflets GEA-3443 (Pyranol), GEA-2018 (oil, 24 kva and smaller), GEA-2985 (oil, 34.5 kva and larger).

Dry-type regulators—Automatic type: Provide 10% regulation raise and lower on circuits such as diagram 2. Remote-motor-hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts. Described in Leaflet GEA-3057.

Dry-type transformers and autotransformers—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage, and phase changing. See diagram 3. Ratings up to 100 kva, 600 volts. Ask for Leaflet GEA-897.

Pyranol capacitors (series or shunt type)—For reducing kva demand, improving power factor, increasing circuit loadability on such circuits as shown in diagrams 5, 6, 9, 10. Described in Leaflet GEA-2742 for circuits 575 volts and below; Leaflet GEA-2860 for circuits 2400 to 13,800 volts.

"Auto-switch" capacitors—For application on high-voltage side of step-down transformers. Units are automatically connected or disconnected with rise or fall of voltage or current. Ideal for improving power factor at heavy load without causing overvoltage at light loads, thus reducing burnouts and replacement of lamps, coils, etc. Detailed information on request.

They will help you gain some or all of these benefits

- ★ Improved lighting (higher levels and the reduction or elimination of flicker); better starting of fluorescent lighting; longer lamp life
- ★ Increased motor efficiency; greater starting and running torque and speed; the reduction of motor heating and, hence, maintenance and machine outages
- ★ Reduced breakage and spoilage in textile and other mills where motor speeds must be constant
- ★ Better performance and greater reliability of electric equipment; the elimination of sluggish operation of potential or control devices
- ★ Greater production from electric furnaces, infra-red heaters, drying lamps, and a wide variety of other electric equipment
- ★ Quality control and greater uniformity, fewer rejects, more accurate test results
- ★ Temperature control on heating circuits
- ★ Longer life of electric equipment; a reduction of overheating and burnouts; the protection of precision tools, electronic tubes, and delicate instruments
- ★ Kva demand reduced, power factor improved, increased circuit loadability and, often, reduced power cost

GOOD voltage is no longer a luxury. It is now easy and inexpensive to extend the benefits of good voltage to every nook and corner of your plant—benefits that quickly pay for the small initial cost of equipment.

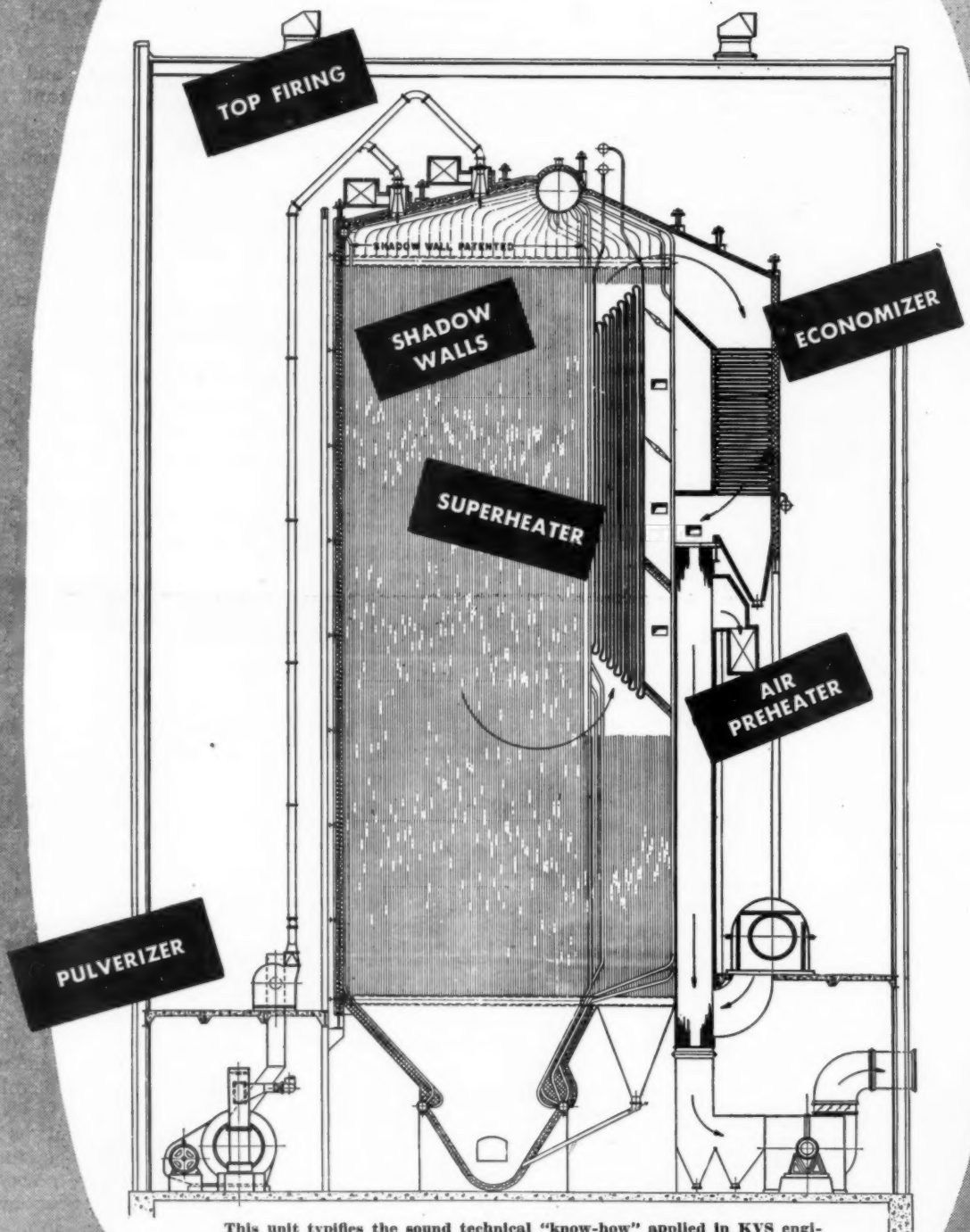
By good voltage we mean voltage that is neither too high, nor too low, nor extremely variable. A 10 per-cent *overvoltage* reduces incandescent-lamp life 75 per cent, decreases the power factor of general-purpose motors from 3 points at full load to 5 and 6 points at half load, and causes overheating in various potential devices. A 10 per-cent *undervoltage* decreases the light output of incandescent lamps approximately 30 per cent, increases the temperature rise of general-purpose motors 6 to 7 degrees C, reduces their torque and overload capacity approximately 19 per cent, cuts the output of a typical heating oven from 1500 to 1275 pounds per hour. Studies of the effect of poor voltage on other electric equipment show similar losses.

If you suspect poor voltage of being the cause of pepless motors, poor lighting, or production slumps at your plant, we'll be glad to help you make a system study. This will determine what corrective measures are necessary. Remember that whether you need voltage regulation for your plant as a whole, for your laboratory, for a vacuum tube, or a power shovel there is a simple, economical G-E device for the job. *General Electric, Schenectady 5, N. Y.*

GENERAL ELECTRIC

403-78-5205

KVS STEAM GENERATING



This unit typifies the sound technical "know-how" applied in KVS engineering by providing adequate furnace volume, combustion equipment and all related components. High efficiencies with any grade of coal that will be available for many years to come are thereby assured.

EQUIPMENT...

provides latitude in proportioning to assure efficient operation on any type of fuel

- **SHADOW WALLS** KVS furnace shadow walls present one of the most efficient radiant heat designs in modern steam generators. This furnace design eliminates convection boiler surfaces, permits the use of a single drum for steam collection and assures even control for all loads within the limits of the design.
- **SUPERHEATER** A pendant type superheater with thermostatically controlled by-pass damper arrangement affords control of superheat temperature over the entire boiler range.
- **TOP FIRING** This feature of KVS design permits the burning of either bituminous or anthracite coal with equally assured success.
- **PULVERIZER** Perfect pulverization with the KVS Integral Drive Tube Mill is controlled by air separation. Low power and maintenance costs can be depended on regardless of the grade of coal handled. Proper preparation of all grades is assured.
- **ECONOMIZER** The convection sections of the economizer are located directly back of the convection superheater. Gas enters at the top and provides a counterflow to the water circulation thereby assuring a high ratio of heat transfer and increasing the overall efficiency of the steam generator.
- **AIR PREHEATER** This component is of tubular design. Down flow of gases within the tubes and upward circulation of the air surrounding the tubes result in high temperature air necessary for perfect combustion.

Engineering Service

KVS offers a complete service for the design, building, erecting and furnishing complete, ready-to-operate steam generating plants including all essential components. This service is available under one responsibility.

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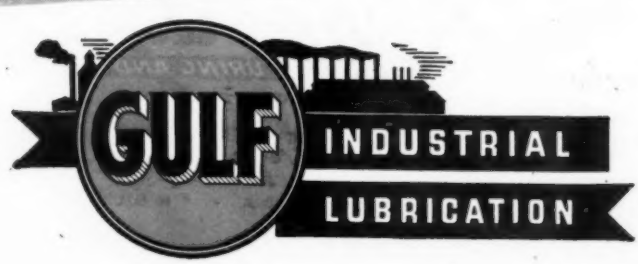
Gulfcrest

a great turbine lubricating

- Greater resistance to oxidation
- Outstanding resistance to corrosion
- Nonfoaming



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oil further improved!

NOW IT'S GULFCREST OIL WCR! Long known for its unmatched performance in the turbine systems of leading power plants throughout the country, Gulfcrest Oil has been further improved—even greater resistance to oxidation, maximum resistance to corrosion, and nonfoaming under any service condition.

In your turbines, this improved oil means better lubrication, better protection against rust and sludge, maximum insurance against outage, and lower maintenance costs. More than ever, Gulfcrest is the world's finest oil for steam turbine lubrication!

Like other top quality Gulf lubricating oils, Gulfcrest Oil WCR is not only refined by conventional methods, but is superrefined by the Alchlor Process, which gives it remarkable stability and long life.

For further information on this new improved turbine lubricating oil, mail the coupon below, or get in touch with your nearest Gulf office.

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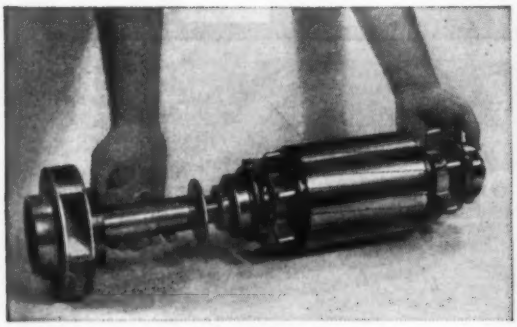
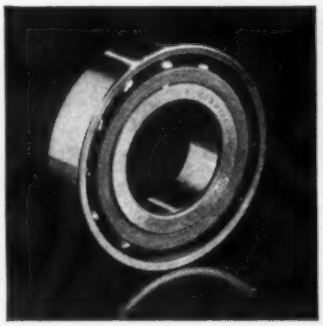
[PUMP TIPS FROM ALLIS-CHALMERS — ONE IN A SERIES]

How to make CENTRIFUGAL PUMPS Last Longer...

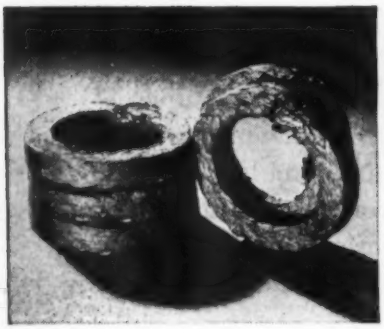


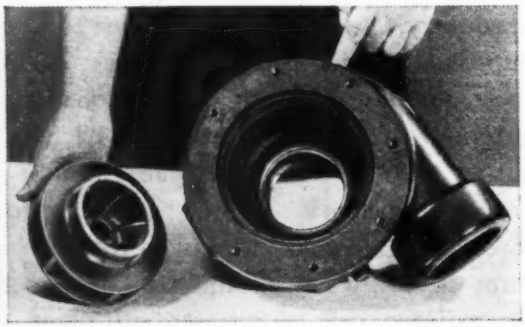


1 WHEN YOU HAVE an A-C "Electrifugal" pump you don't have alignment problems, for *both* impeller and rotor are mounted on *one* shaft. However, most pumps are coupled to separate motors . . . and how well the two are kept in alignment has a lot to do with how long they last. For timely help, get your *free* copy of Allis-Chalmers' "Handbook for Wartime Care of Centrifugal Pumps".

2 ALL BEARINGS AREN'T ALIKE. For example, while too much lubricant won't harm sleeve bearings, in anti-friction bearings it *promotes* friction. So play safe . use only the *right* amount of the *right* lubricant — as recommended by your manufacturer.

3 SLEEVES WEAR UNDULY when water seal piping is plugged, lantern ring displaced, water is dirty or stuffing box gland is drawn too tightly. By keeping a constant check on such sources of wear, sleeve life can be materially lengthened. For valuable tips on how to locate, how to remedy these and other pump troubles, consult the "Handbook".





4 THE KIND OF PACKING, and *how* you use it have a lot to do with how long your pumps last. Commonest cause of trouble traces back to lack of "know-how" in caring for stuffing boxes. A quick picture of the *how* and *why* of efficient packing can be found in the "Handbook".

5 AN OFTEN OVERLOOKED CAUSE of impeller and casing wear is cavitation. For if a pump's capacity, head and particularly, suction lift aren't figured properly, this enemy can eat vital parts away fast. Allis-Chalmers' "Handbook for Wartime Care of Centrifugal Pumps" contains a step-by-step method for figuring head, plus tables of losses to help you apply your pumps correctly.

TODAY, with pumps working harder than ever and replacements difficult to obtain, you can't afford to take chances on maintenance. That's why Allis-Chalmers has published its "Handbook for Wartime Care of Centrifugal Pumps".

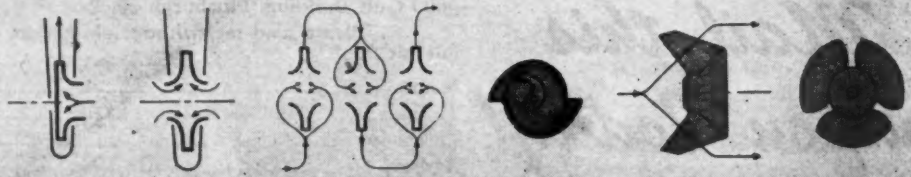
Write for your *free* copy of this valuable book today! It applies to *all* makes of pumps; contains *no* advertising.

And when you *do* need new pumps, look into the extra efficiency of A-C centrifugal pumps . . . the "Electrifugal", and all types for every purpose. ALLIS-CHALMERS, MILWAUKEE.

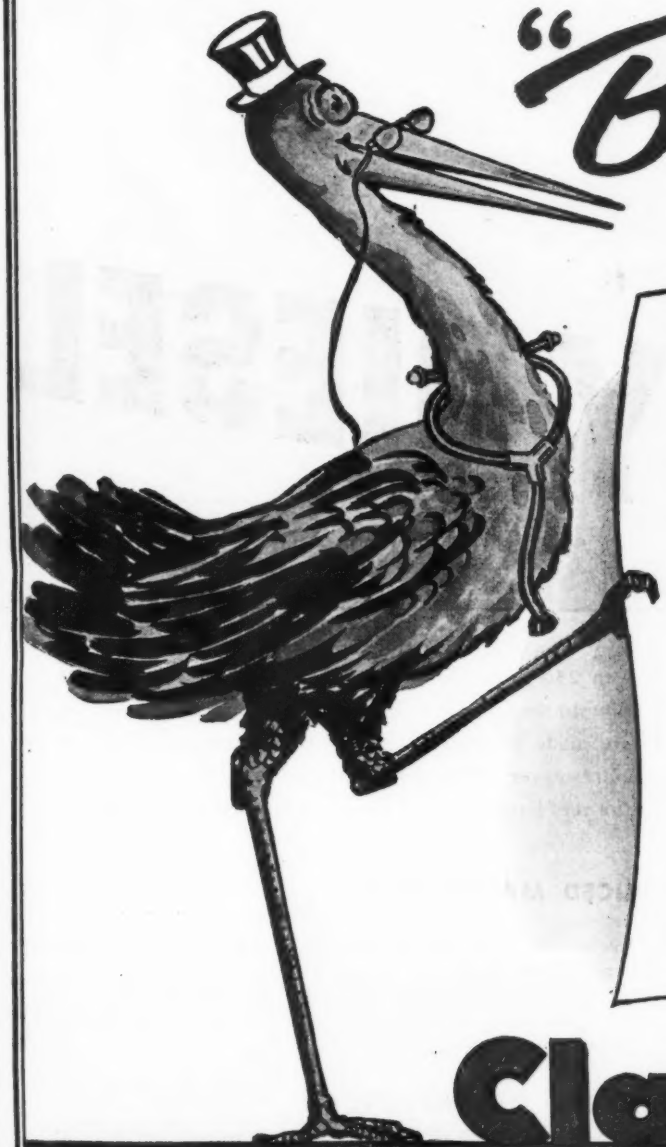
A 1776

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.



WE TAKE PRIDE IN ANNOUNCING A



"Blessed Event"

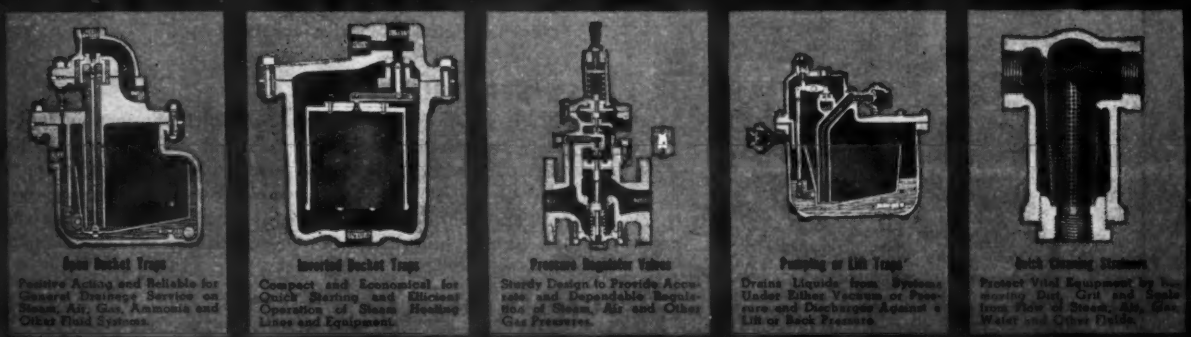
For thirty-seven years we have manufactured fluid controls of high quality that were marketed under an old nationally known name.

We have now assumed the distribution of our own products, which will henceforth be sold under the name "CLARK FLUID CONTROLS."

The Clark Manufacturing Company's long years of experience in the engineering, developing and manufacturing of steam specialties is now directly available to you.

Clark

FLUID CONTROLS



Open Bucket Traps
Positive Acting and Reliable for General Drainage Service on Steam, Air, Gas, Ammonia and Other Fluid Systems.

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Compact and Economical for Quick Starting and Efficient Operation of Steam Heating Lines and Equipment.

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Drains Liquids from Systems Under Either Vacuum or Pressure and Discharges Against a Lift or Back Pressure.

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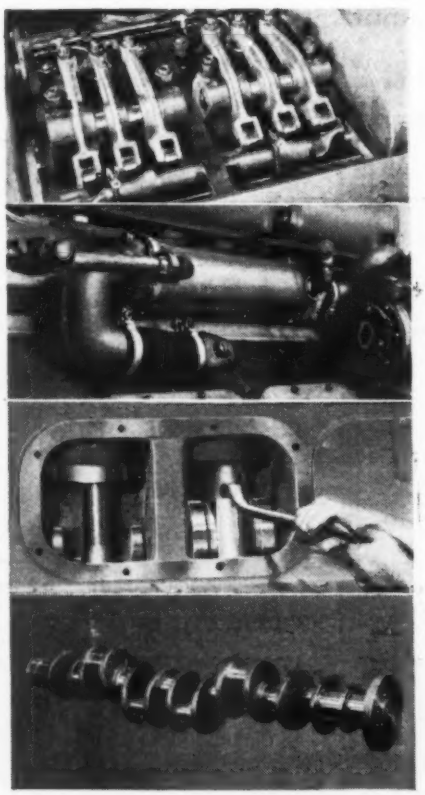
Announcing:

THE NEW SERIES 20 HENDY DIESEL

NOW in the 190 to 250 horsepower range—Hendy Series 20 Diesels bring new standards of dependability and economy to the industrial field. They are designed from the owner's viewpoint entirely—no concessions were made in design, use of old patterns, practices, or tooling. Consequently, Series 20 Diesels have features never before available in engines of this size. The industrial users of Diesel power can *now* obtain the very latest in tested Diesel-engine performance.



REDUCED MAINTENANCE:

Unit fuel pumps and injectors and the overhead camshaft eliminate all high-pressure fuel lines and many moving parts. Air-starting valves, intake and exhaust valves, and fuel injectors and pumps are actuated by rocker arms bearing directly on the overhead camshaft. Inspection and adjustments of valves and injection system can be made by removal of cylinder-head covers.

EFFICIENT OPERATION:

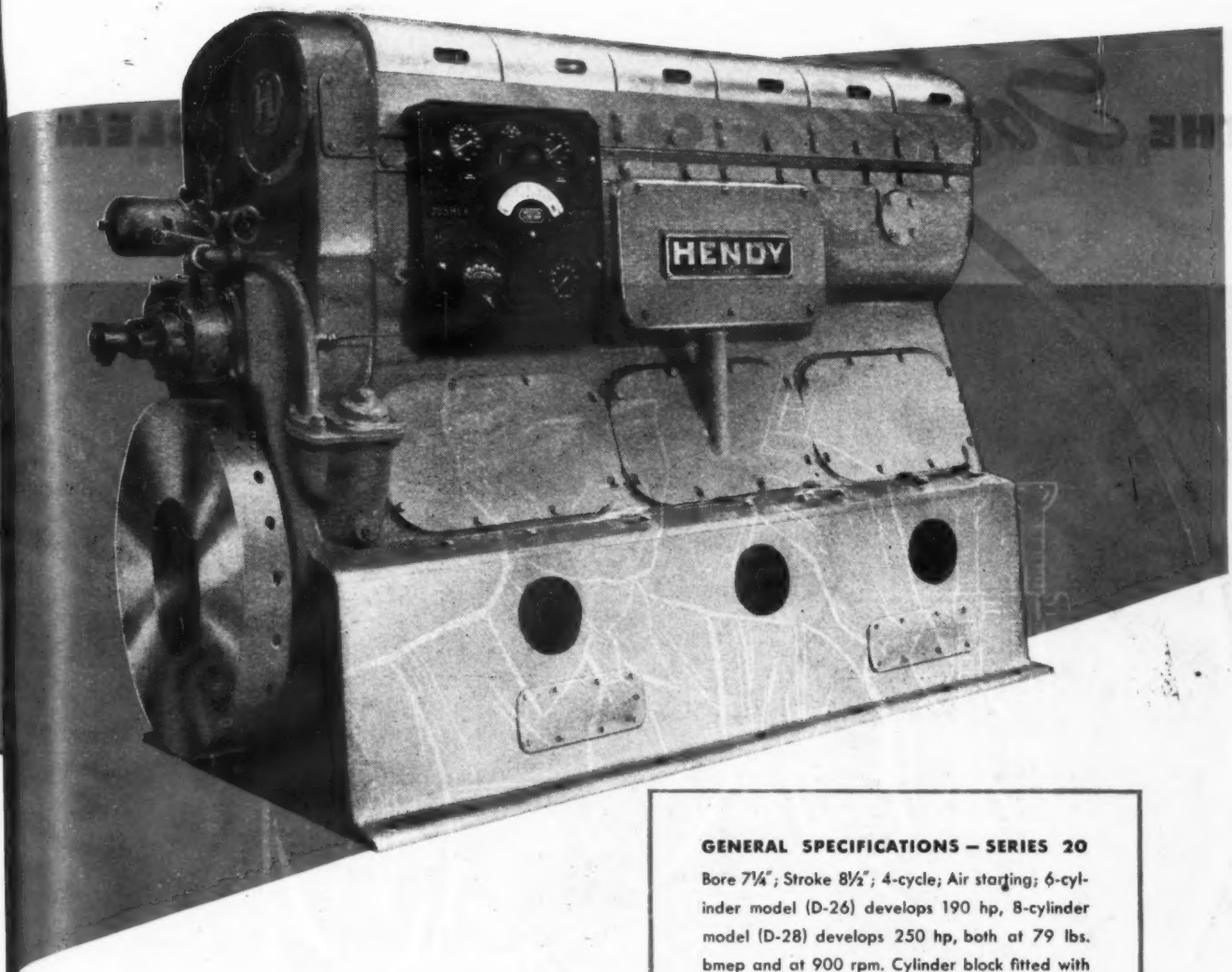
Full pressure lubrication to moving parts provides correct lubrication at all times. An integral oil-cooler keeps the oil at an efficient operating temperature. Uniform cylinder and head temperatures are assured by high velocity, controlled flow of the cooling water and the advanced design of the water jackets.

EASY SERVICING:

Fuel-oil filters, lube-oil conditioners, and fuel-transfer and lube-oil pumps are conveniently located for easy and quick servicing. Each can be removed without disturbing other assemblies. Unit fuel pumps and injectors can also be easily removed for inspection or service. Main and crankpin bearings are readily accessible by quickly removing the large hand-hole plates...without disturbing any other assembly.

LONGER LIFE:

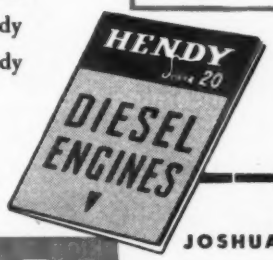
The crankshaft is dynamically balanced, to minimize vibration at *all* speeds, and is large and well proportioned to assure long life and smooth operation. All bearing surfaces receive positive pressure lubrication. The crankshaft is supported by large, replaceable, bronze-backed bearings.



GENERAL SPECIFICATIONS – SERIES 20

Bore 7¼"; Stroke 8½"; 4-cycle; Air starting; 6-cylinder model (D-26) develops 190 hp, 8-cylinder model (D-28) develops 250 hp, both at 79 lbs. bmep and at 900 rpm. Cylinder block fitted with wet-type replaceable liners; Cylinder heads individually cast; Exhaust manifold water-jacketed and cast in sections; Pistons, cast iron; Full pressure lubrication to moving parts, with oil cooled and filtered before entering distribution manifold. Optional equipment includes: closed-circuit cooling systems; clutch power take-offs from either end; belt-driven starting-air compressor. Also available as complete electric generating plants.

Diesel-power users will appreciate many important features in addition to those listed at the left. These new engines were designed specifically to meet the most rigid tests for economy and maximum dependability. And, what is equally important, they are built by skilled mechanics in plants unusually well equipped with modern, precision machine tools that take full advantage of production-line methods. Other Hendy Diesels available up to 800 horsepower. Joshua Hendy Iron Works, Sunnyvale, California.



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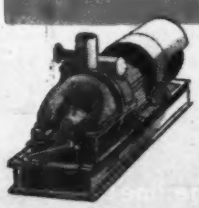
HENDY

REDUCTION GEARS



TURBO-GENERATORS

TURBINES

JOSHUA HENDY IRON WORKS
ESTABLISHED 1856
SUNNYVALE, CALIFORNIA

Please send me complete details on Hendy Series 20 Stationary Diesel engines ☐. Hendy Series 20 Diesel-generator sets ☐.

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94-D-18

THE *Solution* CAUSED THE PROBLEM

HERE'S WHAT HALL CLIENTS GET:

1. Thorough study of all factors concerning water involved in producing steam.
2. Procedure for the proper treatment of boiler water.
3. Instruction of designated employees in making of essential control tests.
4. Periodic check up by Hall service engineers.
5. Periodic checking of samples by Hall Laboratories.
6. "Trouble shooting" that includes all service necessary as problems arise.

—all of which adds up to boilers that stay on the line!

HAGAN
HALL
BUROMIN
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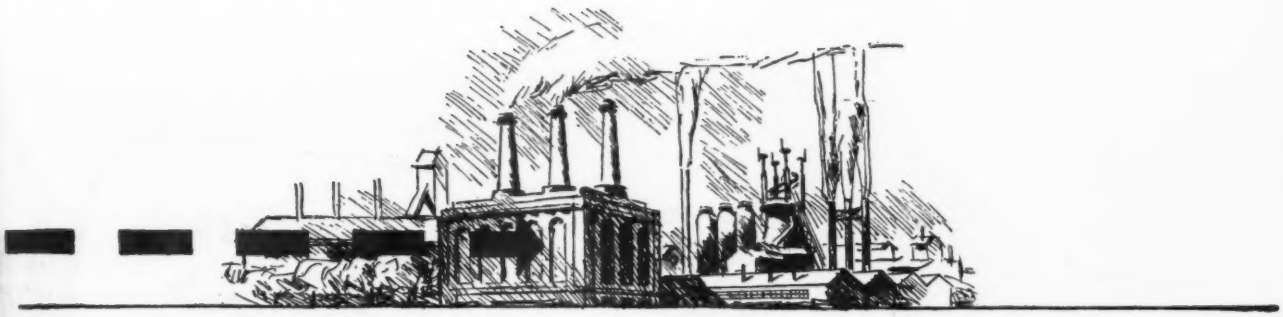
IN THIS STEEL MILL POWER PLANT



The boiler water was okay, so the plant engineer was satisfied.

The Hall service engineer was not. He found that the plant was using 110 pounds of phosphate daily, and he knew that it should not be more than 50 pounds a day, at most.

His check-up showed that there were no raw water leaks, and no sludge in the water coming from the softener. As a final point in his checking, he brought to Pittsburgh a sample of boiler water and also a sample of the molybdate solution used in testing it.

When analysis of the boiler water showed a great excess of phosphate, Hall chemists turned to the molybdate solution the mill had been using in its own tests.

It was quickly evident that the solution was the source of the trouble. This had been supplied by the mill's own laboratory, and instead of following Hall instructions as to strength the laboratory had made up the same weak solution required for certain steel tests. As a result, tests made with this solution indicated a need for far more phosphate than was actually required.

The Hall service engineer had already arbitrarily reduced the amount of phosphate used to 75 pounds a day. Now, on the basis of accurate tests, it was reduced to less than 50 pounds.

Hall service engineers take nothing for granted. They check all factors involved in boiler performance, and, in the event of trouble of any kind, they trace the trouble to its source.

Every plant that generates its own steam power can profitably use Hall Service.

Write us for full information.

HALL LABORATORIES, INC. · HAGAN BUILDING · PITTSBURGH 30, PA.

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HALL SYSTEM *of Boiler Water Conditioning*

S-M-O-O-T-H

PERFORMANCE...

For cleaner turbines—less wear—lower operating costs ...the New **TYCOL RIO Turbine Oils**

These new Tycol RIO Turbine Oils set a new standard for service performance. They combine all of the factors needed to make an ideal turbine lubricant—purity of refinement . . . service endurance . . . high rust and oxidation inhibiting qualities.

As a result of long, exhaustive service in actual turbine units — already showing definite rust development when operated on conventional type turbine oil — the superiority of these RIO oils, both as an economical lubricant, rust and oxidation inhibitor, is a matter of record.

So, if moisture is a factor in your turbine operations, you can depend on RIO oils, with their high rust inhibiting properties. They also provide unsurpassed protection against oxidation . . . with maximum lubrication efficiency.

Your nearby Tide Water Associated office can give you full data about these new oils. Get in touch with them today.

DRUMS! DRUMS! DRUMS!

War needs make it imperative that all empty drums be returned immediately.

INDUSTRIAL TYCOL OILS-GREASES

TYCOL INDUSTRIAL

ENGINEERED FOR EVERY

M-A-X-I-M-U-M EFFICIENCY

with TYCOL

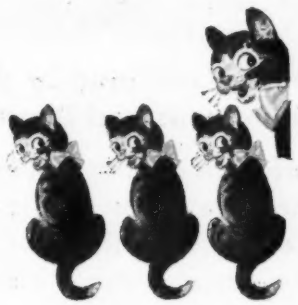
ENGINEERED LUBRICATION

Under all conditions the proved performance of Tycol lubricants more than meets their recommended service.

Rigidly controlled and tested during manufacture . . . and refined from the highest grade crudes, Tycol oils and greases (whether straight mineral or compounded) retain their uniformity* within each classification – from the first drum to the last. This unvarying high quality, plus the scope of the line, accounts for Tycol's wide acceptance among operators interested in maximum production . . . top efficiency . . . lowest operating cost.

Whatever your lubrication need, there is a Tycol oil or grease expressly engineered to afford greater economy . . . longer machine life for every type of equipment. Let a Tide Water Associated engineer help you select the best one for your particular need. Call, write or wire your nearest Tide Water Associated Office for full details.

Makers of Famous Veedol Motor Oil



*** UNIFORMITY.** For clear, concise descriptions of the basic tests used to determine important lubrication properties – Pour Point, Extreme Pressure, Uniformity and many others – consult Tide Water Associated's informative handbook "Lubricania". For your FREE copy write: Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

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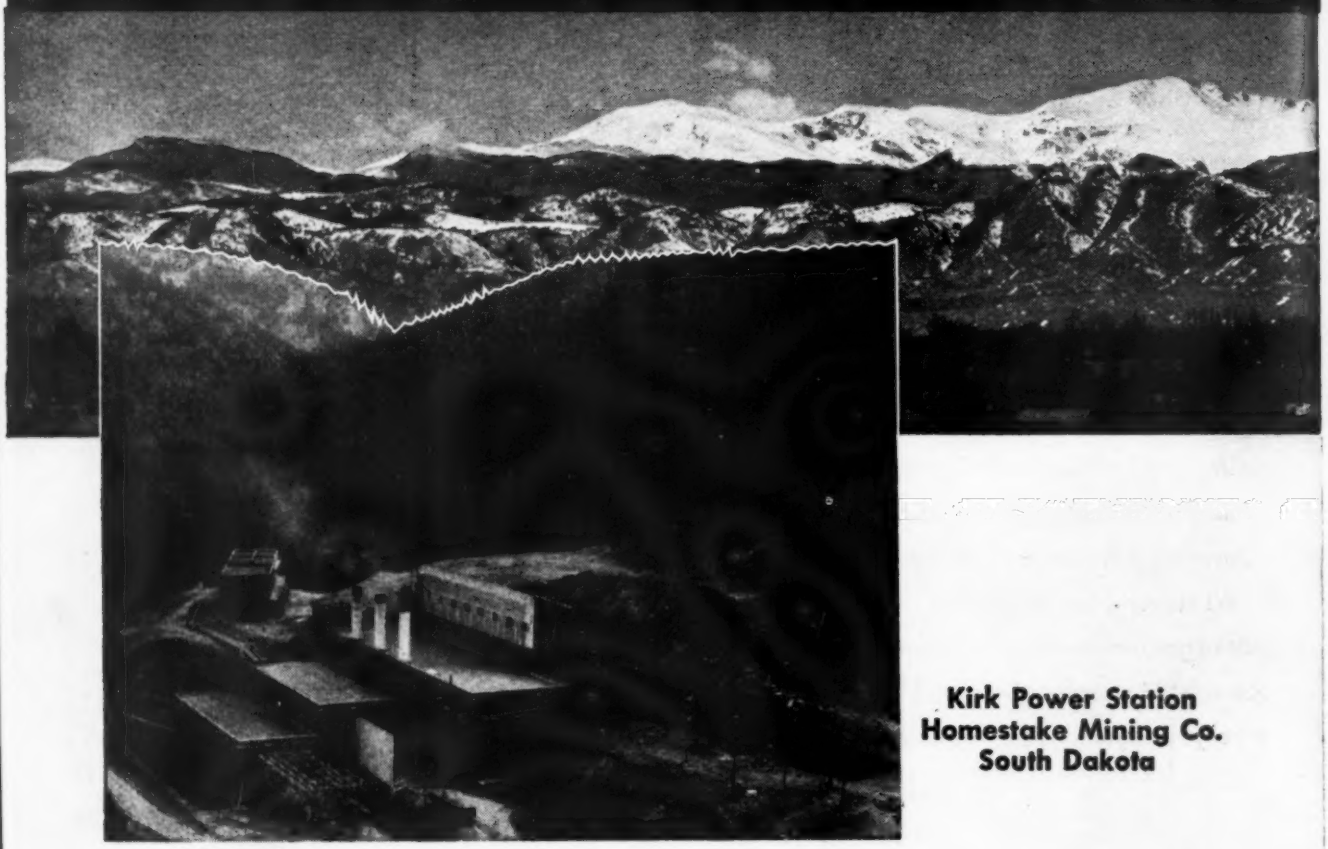
WHY



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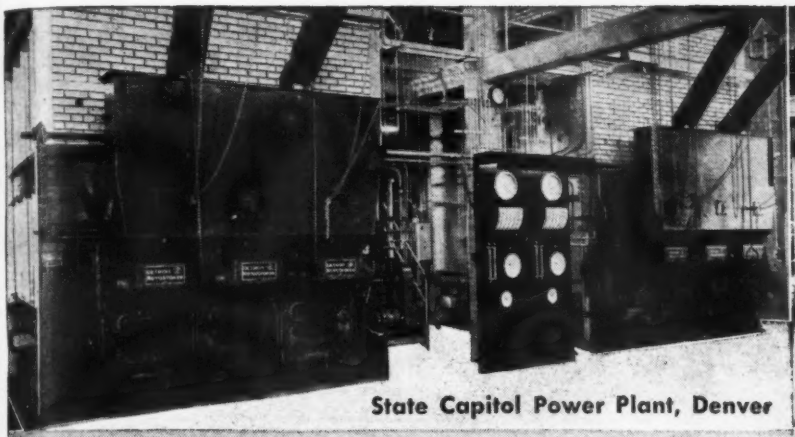
South Dakota

RotoStokers are used in the West because of their ability to burn Lignite, Sub-bituminous and Bituminous coals, mined in the Western States.

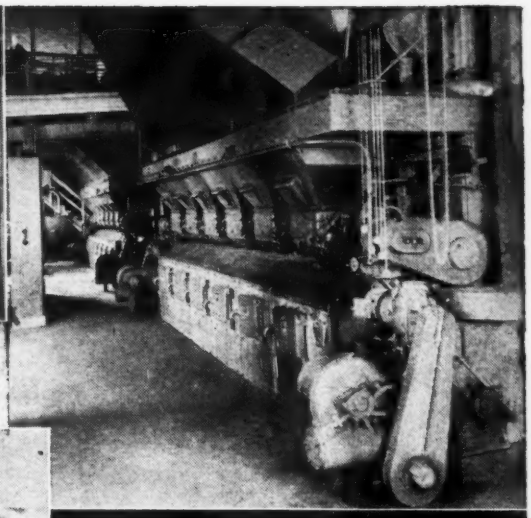
Fuels of high or low ash content without special preparation are used. High burning rates—for long periods. Even fuel beds maintained, regardless of changes in load. Reliable with both steady and variable conditions. High CO_2. Low combustible loss.

Investigate Detroit Stokers. They cut the cost of producing steam. Write for bulletin now.

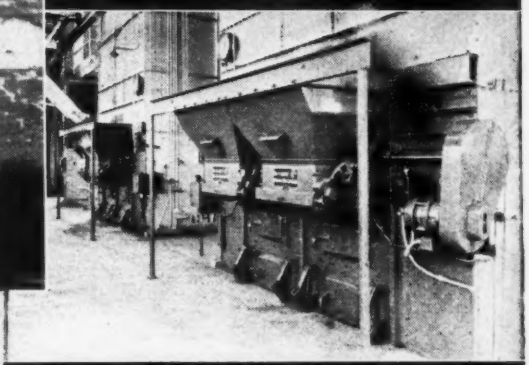
DETROIT STOKER COMPANY



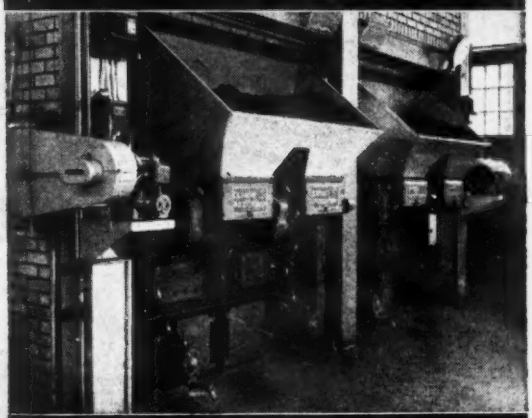
State Capitol Power Plant, Denver



Rocky Mountain Arsenal, Denver



Municipal Plant
Fort Collins, Colorado



State Penitentiary Plant
Canon City, Colorado

American Crystal Sugar Co.
Missoula, Montana

• Detroit Stoker Users in the Rocky Mountain Area

Armour & Company
Fort Morgan, Colorado
Denver Ordnance Plant
C., B & Q. Railroad
Colorado Utilities Corporation
National Sugar Mfg. Company
Denver Medical Depot
Albuquerque & Cerrillos Coal Co.
University of Colorado
Camp Carson
Vanadium Corporation of America
Colorado State Hospital
Pikeview Mine
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Built in Canada at London, Ontario

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now your Big drives

NEW 2000-hp INDUCTION MOTOR LARGEST MEMBER OF TRI-CLAD FAMILY

Dwarfing the original Tri-Clad motor (resting on the conduit box) in size, this new 2000-hp "big brother" embodies all the same protective construction features.

It operates at 1800 rpm, on 2300 volts, 60 cycles. This new 3-phase motor is in the 6360-frame series, which is five steps larger than the largest standard industry frame size (namely 505).

*THE EXTRA

TRI/CLAD

REG. U.S. PAT. OFF.

Special motors can be custom built in Tri-Clad design for *your* problem

Your exceptional drive requirements may call for an induction motor specially designed to the job. Whatever its rating, it can generally be built with many of the Tri-Clad motor's strong points, such as enclosed upper portion, smooth cast-iron end shields, windings of Formex wire, and double-end ventilation.

General Electric's special motor engineering has produced the world's fastest motor, the world's strongest motor, and many other tradition-breaking designs. We'll welcome your unusual problems.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES	
TRI/CLAD **Type K**	**1 hp to 2000 hp at 1800 rpm**
TRI/CLAD **Type KG** (High starting torque, low starting current)	**5 hp to 200 hp at 1800 rpm**
TRI/CLAD **Type KR** (High starting torque, high slip)	**Available to 100 hp in speeds required for high-slip flywheel drive (punch press, etc.)**

Buy all the BONDS you can—*and keep all you buy*

can have it, * *too*

PROTECTION OF CONSTRUCTION

G-E STANDARD Tri-Clad Induction Motors Now Available to 2000 hp

For that important *big* drive (up to 2000 hp, 1800 rpm) you can now get a G-E standard Tri-Clad induction motor. All the protective features that have proved so valuable to service continuity and long life in the more widely used sizes are included:

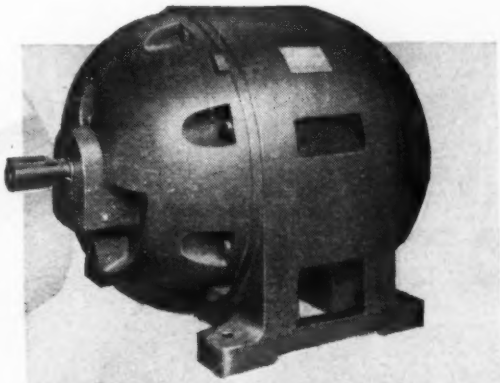
EXTRA PROTECTION FROM PHYSICAL DAMAGE—Cast-iron construction with upper portion completely enclosed to keep out falling objects, dripping liquids. Streamline, cast-iron end shields. Corrosion-resisting finish.

EXTRA PROTECTION FROM ELECTRICAL BREAKDOWN—Windings of Formex* wire are solidly bonded with synthetic resins strongly resistant to heat, oil, and moisture. Formex wire insulation stands up strongly under abrasion or "heat-shock."

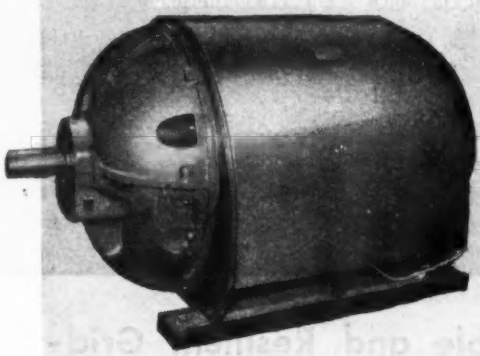
EXTRA PROTECTION FROM OPERATING WEAR AND TEAR—Available with either sleeve or ball bearings—in dust-tight housings. Sleeve-bearing design is a further refinement of well-proved Tri-Clad motor bearing proportions, efficiently lubricated, with "air seal" to insure oil tightness of the housing.

The Tri-Clad, in its wide range of types and sizes, is G.E.'s most widely used (integral-hp) motor. Chances are that there's a Tri-Clad to meet your requirements "on the nose." For information on General Electric's complete line of Tri-Clad motors, ask for GEA-3580. *General Electric Company, Schenectady 5, N. Y.*

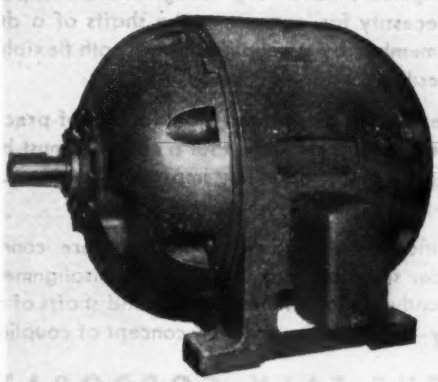
*Trade-mark reg. U.S. Pat. Off.



Typical large-size sleeve-bearing Tri-Clad polyphase motor, now standard up to 2000 horsepower.



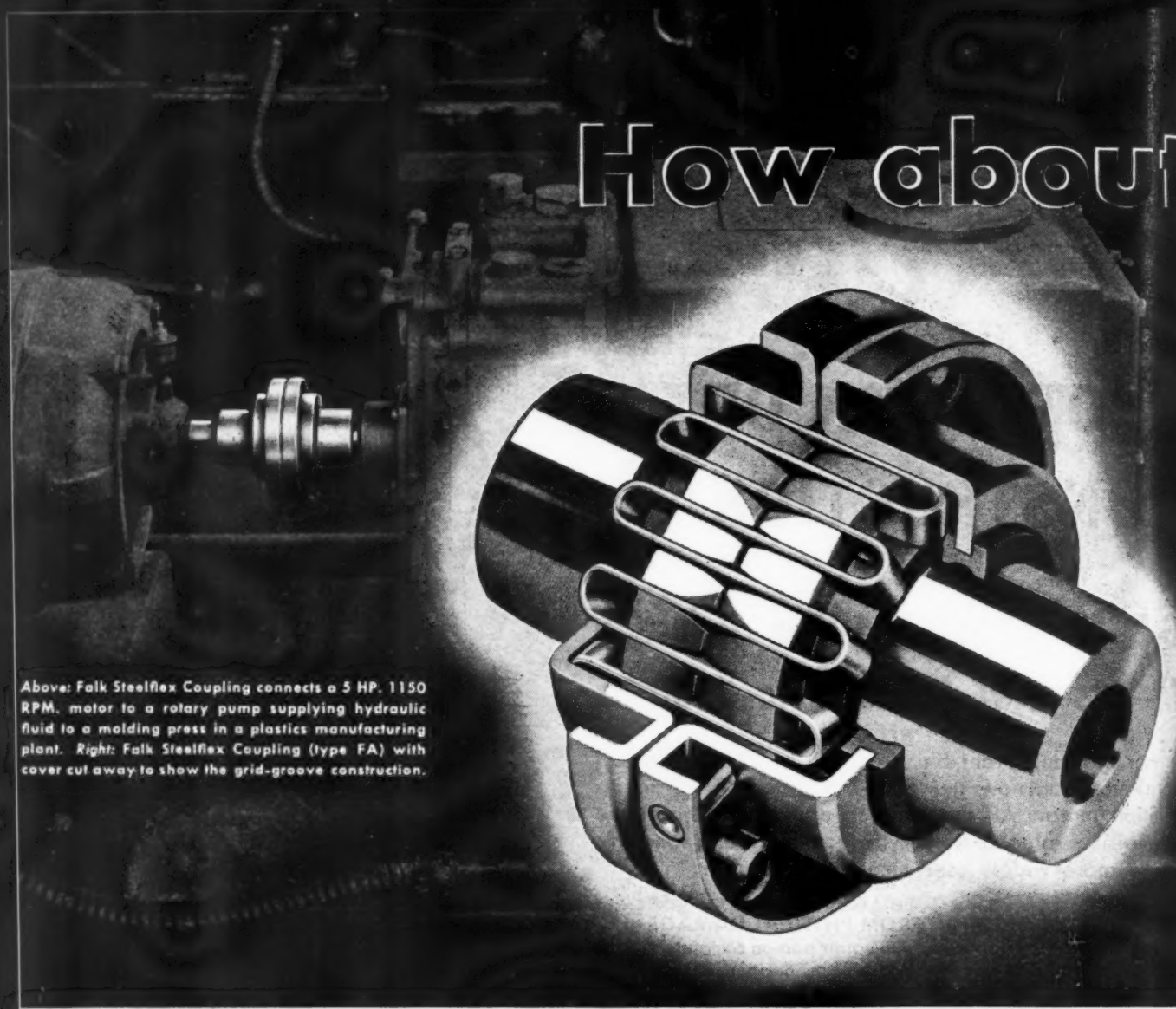
Modified cast-iron frame construction used for certain large sizes of the extended Tri-Clad motor line.



Separable housing construction used for large-size ball- or roller-bearing Tri-Clad motors. Roller bearings are standard at coupling end.

GENERAL ELECTRIC

How about



Above: Falk Steelflex Coupling connects a 5 HP. 1150 RPM. motor to a rotary pump supplying hydraulic fluid to a molding press in a plastics manufacturing plant. *Right:* Falk Steelflex Coupling (type FA) with cover cut away to show the grid-groove construction.

Flexible and Resilient Grid-Groove Design Effectively Cushions Loads . . . Absorbs Shocks . . . Adjusts for Misalignment . . . Provides for End Float

FALK Engineers have long recognized the importance of, and necessity for, connecting the shafts of a driving and a driven member by a coupling that is both flexible and torsionally resilient.

As pioneers in the design and manufacture of precision gear drives, these engineers know that a coupling must be resilient to the degree that it definitely improves the character of the motion imparted to it.

This qualification extends beyond the mere connecting of shafts under slight angular and parallel misalignment without imposing undue loads on the bearings and shafts of connected machinery—which is the ordinary concept of coupling design.

In addition to providing flexibility and torsional resilience, proper coupling design dictates the use of materials that will insure years of trouble-free service.

Therefore Falk Steelflex Couplings provide both essentials of desirable coupling performance, insuring *both* flexibility and the torsionally resilient action that so effectively cushions loads, absorbs shocks, dampens vibration, adjusts for angular and parallel misalignment, and allows free end float for the shafts of driving and driven members.

How and why Falk Steelflex Couplings do all this is explained on the opposite page. Here, indeed, is a short course in efficient coupling design.

THE FALK CORPORATION; MILWAUKEE 8 WISCONSIN

For over fifty years precision manufacturers of Speed Reducers . . . Motoreducers . . . Flexible Couplings . . . Herringbone and Single Helical Gears . . . Heavy Gear Drives . . . Marine Turbine and Diesel Gear Drives and Clutches . . . Contract Welding and Machine Work. • District Offices, Representatives, or Distributors in principal cities.

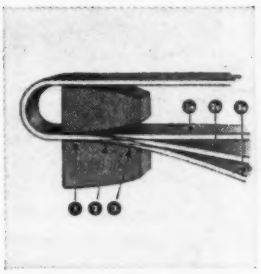
IT ALWAYS PAYS TO CONSULT **FALK**

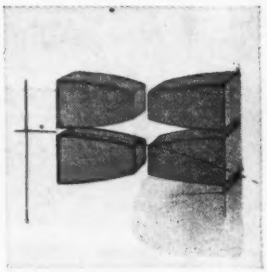
a short course in

Coupling Design?

WHY and HOW Falk Steelflex Couplings Perform Better

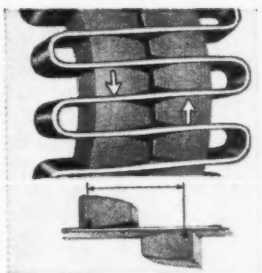
OW THE GRID-GROOVE DESIGN UNCTIONS. Power is transmitted rough a resilient grid member made of rome alloy steel with an elastic limit of 5,000 pounds per square inch and an imate strength of 250,000 pounds r square inch. This grid fits snugly into rved grooves cut into the hubs of the upling.

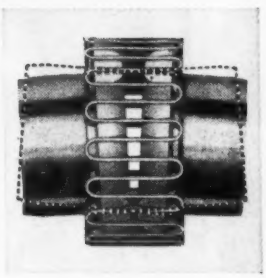




HOW THE GROOVES ARE DESIGNED. The identical hubs are moderately high carbon bar steel, forged steel, or Falk alloy cast steel. Into these hubs, grooves are cut in a precise arc, with radius and length proportional to the size of the coupling, to provide a snugly fitting slot for the grid member and a bearing surface from outer to inner edge of the hub.

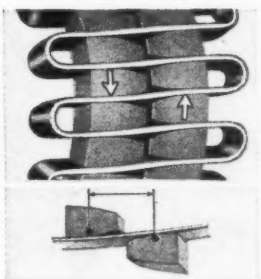
T LIGHT LOADS, the grid member ars only at the outer edges of the rved grooves in the coupling hub, as own at right and at *1* and *1a* in the diaam above. This permits a long, free stic span between the outer edges of th hubs. Power is transmitted through most the entire length of the resilient ngs of the grid member.

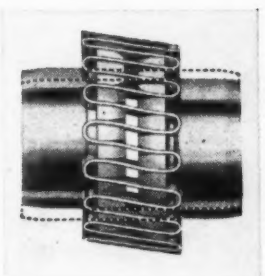




ANGULAR MISALIGNMENT. Under angular misalignment the design of the Falk Steelflex coupling permits a rocking and sliding action of grid and hubs that allows the greatest freedom of accommodation to angular misalignment, while at the same time transmitting the power through the resilient grid with no lost motion or backlash.

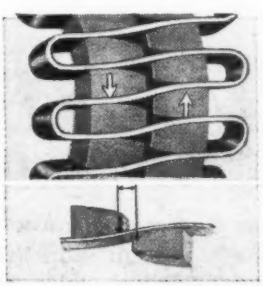
T NORMAL LOADS, the grid bears n a larger area of the grooves (*2*, *2a* in diagram) and the span of the rid is automatically shortened as the ad increases, enabling it to transmit ore power without increasing internal ress. The grid member maintains its pacity to absorb shocks, dampen ibration, and cushion the load.

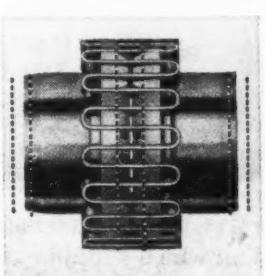




PARALLEL MISALIGNMENT. When parallel misalignment is involved, the resilience of the grid-groove combination comes into full play. The movement of the grid in the lubricated grooves accommodates the misalignment, while still permitting full function of the grid-groove action of the coupling in absorbing shock and dampening vibration.

T PEAK LOADS, the rungs of the grid ember then bear over almost the enre curved surfaces of the grooves (*3*, *3a* in diagram) and the span of the grid ecomes very short. The coupling still emains torsionally resilient. Also under e impact of shock loads the grid ember flexes and transmits power moothly and evenly.





PERMITS FREE END FLOAT. Because the grid member slides freely in the lubricated grooves, the Steelflex coupling permits free and independent end float for the shafts of both the driving or driven members, or of either one. If it is desired that end float be restricted, provision can be made to limit it to any required amount.

There are 13 types and 33 sizes of Falk couplings to meet all requirements. For specific information and recommendations to meet your needs, call the nearest Falk representative or distributor.

FALK ... A GOOD NAME IN INDUSTRY

Specify Republi

A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for percent more building space, generated 114.3 per more electric power but consumed 9.86 percent less

REPUBLIC
INSTRUMENTS
AND CONTROLS

Combustion Control

TO INCREASE TODAY'S STEAM PRODUCTION

TO DECREASE TOMORROW'S STEAM COST

The installation of Republic automatic controls on your boiler (or boilers) will enable you to:—

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hr. a day, 7 days a week.

CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently developes as a result of incorrect boiler operation.

An automatic combustion control system, as designed and built by Republic, will help you meet today's need for more steam and tomorrow's need for lower steam costs.

The Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency. It not only checks operation but automatically makes necessary corrections of individual factors before faulty operation has a chance to develop.

The difference between such a control and an assembly of uncoordinated regulating devices is comparatively small in equipment but great in principle. Merely to provide automatic operation of a number of individual device is not enough.

CHECK THESE FEATURES

Built into the Republic combustion control systems are many features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of everyday operation.

Check the following features against your list of "musts" for a perfect combustion control system.

CENTRALIZED CONTROL: The operation and control of the boiler or boilers is centralized at the master controller.

FUEL-AIR RATIO INDICATOR: The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

FUEL-AIR RATIO ADJUSTMENT: A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

ALL BOILER RATINGS: Maintains proper fuel-air ratio over the entire range of boiler ratings.

CONSTANT STEAM PRESSURE: Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

LOAD DISTRIBUTION: Provides a means of distributing the load among the boilers as desired.

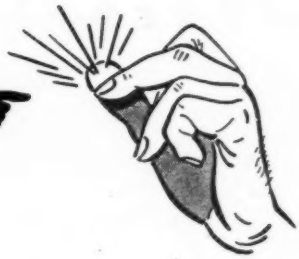
MANUAL CONTROL: Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

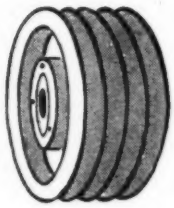
Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

Republic Flow Meters Co.

2240 Diversey Parkway • Chicago 47, Illinois

Just like this



this  goes

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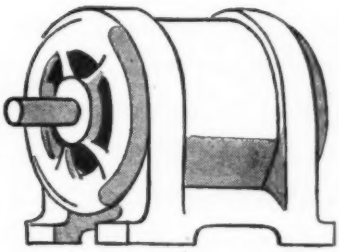


Yes, it's a snap to change sheaves now, when you provide Allis-Chalmers' new "Magic-Grip" — *fastest mounting and demounting sheave on the market.* Saves time and money.

SEE WHY THE NEW "MAGIC-GRIP" MOUNTS FAST, PERFORMS SMOOTHLY

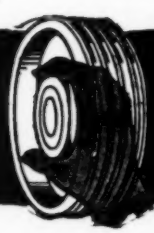
1 **Place sheave on shaft.** Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 **Slide to desired position.** Sliding easily, sheave can be placed *exactly* according to straight-edge ... giving you true alignment with resulting smooth performance. A minimum of time is required.

3 **Tighten three capscrews** — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1857

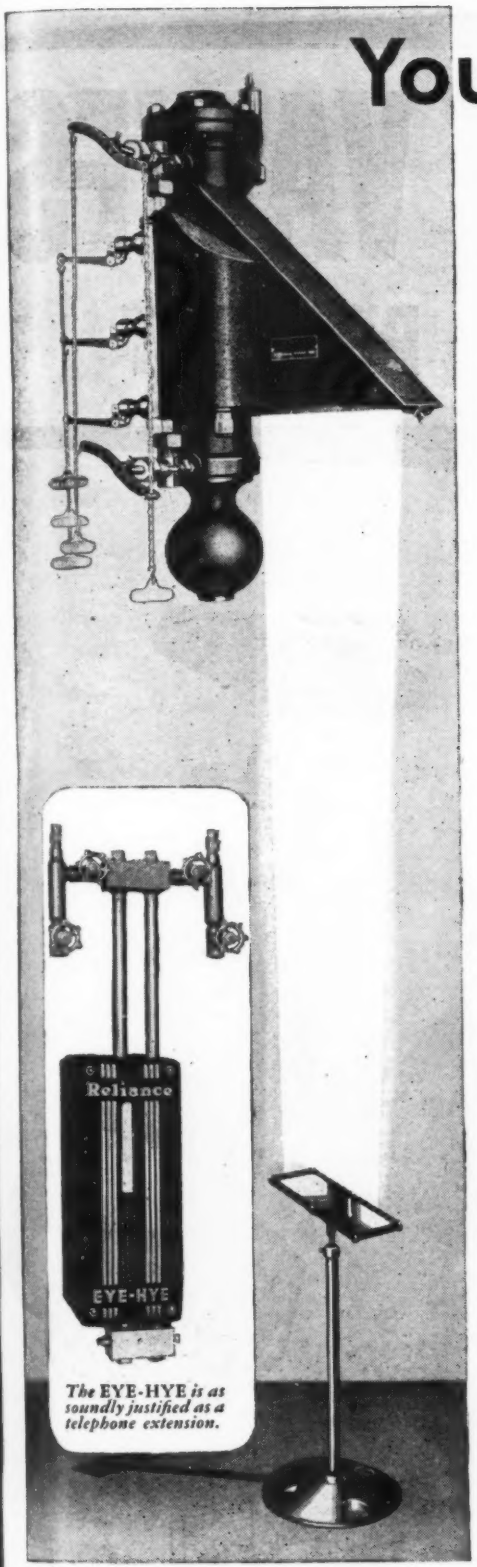
Allis-Chalmers Texrope

"MAGIC-GRIP"  SHEAVES

You are definitely *Dollar-Wise*

when you provide extra safety and efficiency through *duplicate* water level supervision . . .

The Reliance Safety Team double check way *means convenient frequent checks at boiler & control point*



The cost is extremely small—in view of advantages gained—to make your water level indicating installation *complete.* You aren't likely to "shoot the works and hang the cost" as the military forces have to do. So you're not extravagant when you have sensible duplication in your indicating equipment.

This Reliance *double check* gives assurance that boiler room men have ample warning of unsafe or inefficient water levels; through *sound* when the Alarm Water Column whistle blows—through *sight* as EYE-HYE shows an accurate reading at all times, conveniently duplicating at control station or other remote point the reading of the boiler drum gage.

RELIANCE WATER COLUMN EQUIPMENT

RELIANCE SAFETY TEAM
SOUND CHECK ✓ ALARM Water Column
SIGHT CHECK ✓ EYE-HYE Remote Gage

RELIANCE EYE-HYE REMOTE READING WATER LEVEL INDICATOR

Water Columns for all pressures, with and without alarms, and complete "trim equipment" have been the sole interest of Reliance since 1884. Your requirements can be filled with Reliance Gage Valves, Gage Inserts, and Gage Illumination.

EYE-HYE is a convenient auxiliary that brings your water level reading to instrument panel or wall, showing exact indication in a brilliant illuminated green column. Its action is completely hydrostatic . . . dependable and accurate.

Write for full information about the Reliance Safety Team.

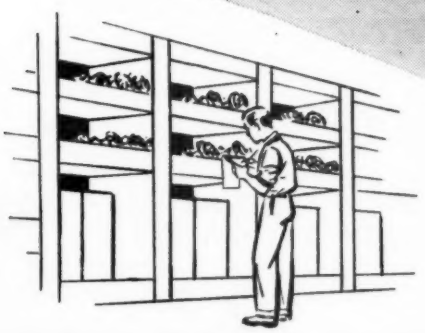
BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

TIGHT VALVES PREVENT

A LUNKENHEIMER DISTRIBUTOR IS LOCATED NEAR YOU, READY AT ALL TIMES TO ASSIST WITH YOUR MAINTENANCE AND OPERATION PROBLEMS. YOU WILL PROFIT BY USING HIS SERVICE.



BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

CONSERVE FUEL-
HOLD-UPS IN PRODUCTION

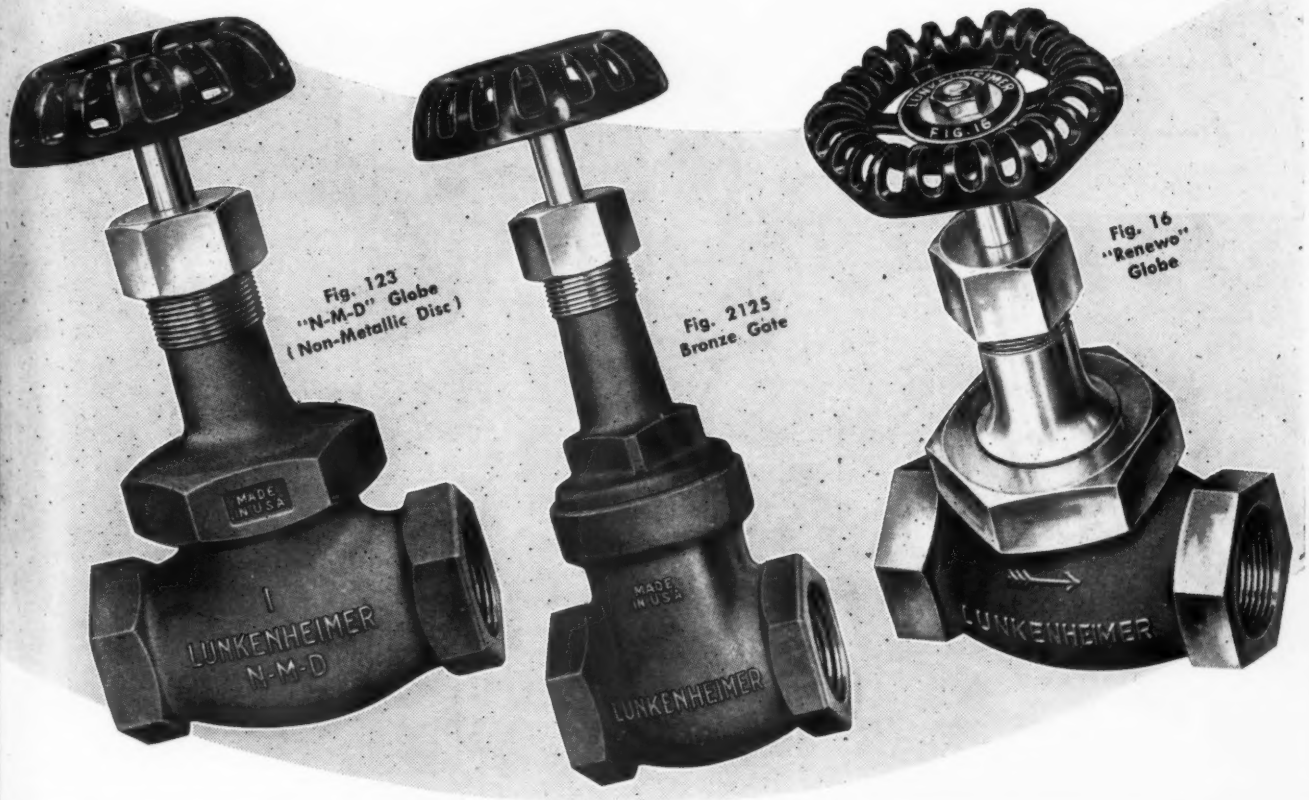
LUNKENHEIMER VALVES STAY TIGHT WITH LESS CARE!

With today's production problems and the urgent necessity for conserving fuel, it is more important than ever to avoid wasteful, costly, production-lowering valve leakage.

It's good business to maintain a regular check on valves, to make sure that they are *tight* and in proper working order.

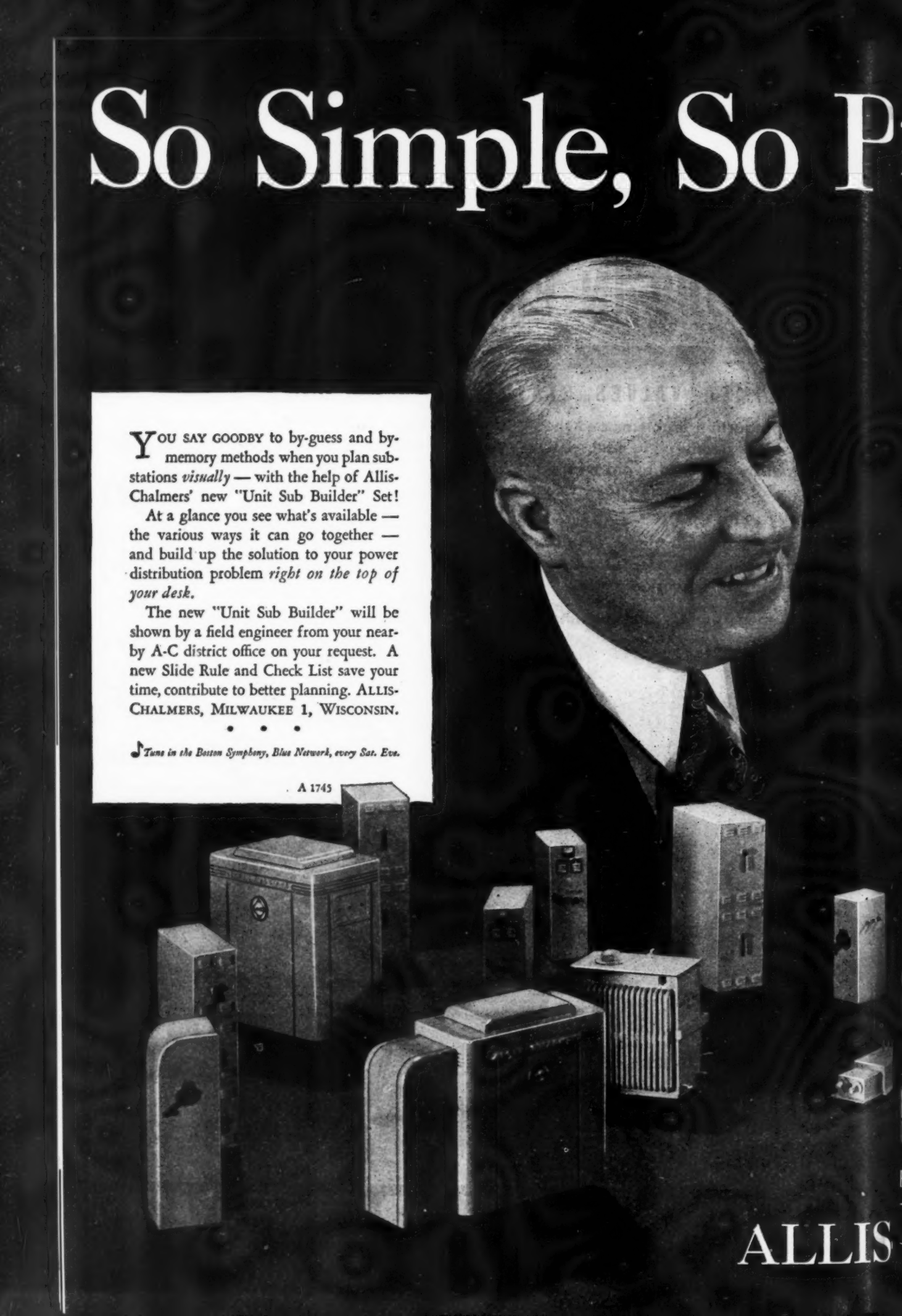
Maintenance men *prefer* Lunkenheimer Valves. They know these *quality-built* Valves serve longer and better on the job —are easier to keep tight with a minimum of time, labor, and expense.

The Lunkenheimer Co., Cincinnati 14, Ohio, U. S. A. *Branch Offices:* New York 13, Chicago 6, Boston 10, Philadelphia 7. *Export Department:* 318-322 Hudson St., New York 13, N. Y.



LUNKENHEIMER VALVES

So Simple, So P



YOU SAY GOODBY to by-guess and by-memory methods when you plan substations *visually* — with the help of Allis-Chalmers' new "Unit Sub Builder" Set!

At a glance you see what's available — the various ways it can go together — and build up the solution to your power distribution problem *right on the top of your desk.*

The new "Unit Sub Builder" will be shown by a field engineer from your nearby A-C district office on your request. A new Slide Rule and Check List save your time, contribute to better planning. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

• • •

♪ *Tune in the Boston Symphony, Blue Network, every Sat. Eve.*

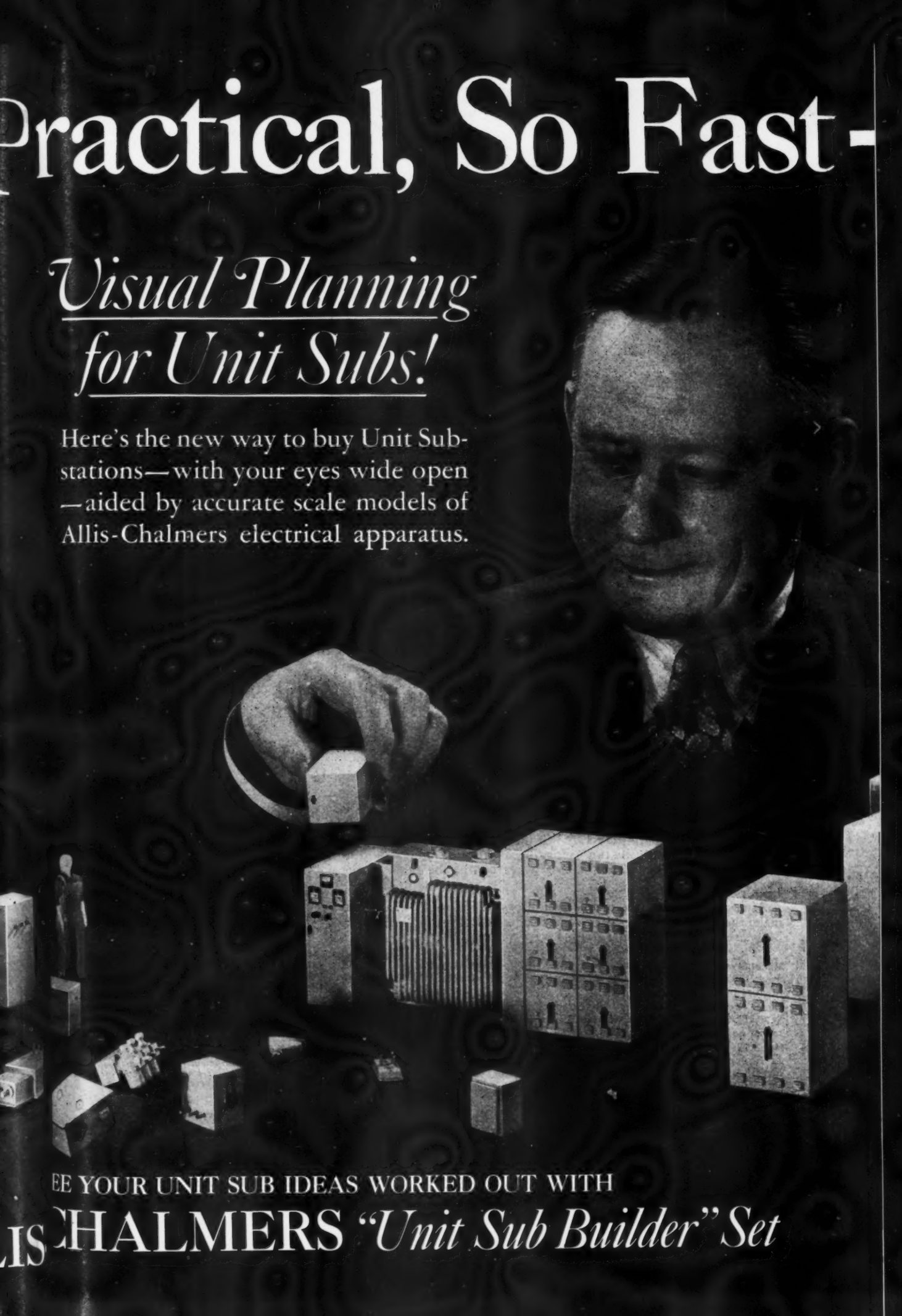
A 1745

ALLIS

Practical, So Fast-

Visual Planning for Unit Subs!

Here's the new way to buy Unit Substations—with your eyes wide open—aided by accurate scale models of Allis-Chalmers electrical apparatus.



EE YOUR UNIT SUB IDEAS WORKED OUT WITH

LIS CHALMERS *"Unit Sub Builder" Set*

THE FOG THAT BLOTS OUT FIRE

OFFICIAL U. S. NAVY PHOTOGRAPH

...starts here

WaterFOG . . . the newest of fire-fighting methods . . . is especially valuable in choking off concentrated fires aboard ship or in plants. Even oil fires and fires around electrical apparatus now can be extinguished with water.

Sending out a stream of atomized water particles, WaterFOG blankets the blaze – chills the heat – cuts off the fire's "breath" – *and smothers the flames.*

In WaterFOG nozzles, tiny openings are so paired that streams of water impinge and shatter into mist.

The nozzle holes are only 1/16" in diameter. Any foreign matter reaching them could easily cause clogging. For protection, two strainers are used; one at the hydrant or water pump; the other in the nozzle itself.

After investigating the metals and alloys which could be used to make these strainers, the Rockwood Sprinkler Company, Worcester, Mass., selected Monel. *For:*

Monel is strong and hard! Tests showed that light-gauge Monel strainers could resist the erosion and abrasion of water and solid particles blasting against them at pressures up to 600 psi.

Monel resists corrosion! Any convenient source of water can be used for WaterFOG. Monel strainers withstand corrosion by all kinds of water – *fresh, salt* or *polluted.*

Monel is readily workable! Strainer openings must be even smaller than the 1/16" openings in the nozzle. In turn, the Monel sheet from which these strainers are made is thinner than the strainer openings. And, as the photographs show, fabricating the strainers requires a ductile material easily shaped. Monel strainers can be joined by welding or soldering.

Rockwood's choice of Monel has paid off well. Every Monel strainer in WaterFOG installations in ships at sea or in industrial power plants ashore is still giving perfect service.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N. Y.

*Reg. U. S. Pat. Off.

FIRE PLUG STRAINER *with Monel strainer. Made by Rockwood Sprinkler Company. Quick-flushing type, approved by the Bureau of Ships, U. S. Coast Guard and Maritime Commission.*

Upper figure shows nozzle with Monel screen. Used in WaterFOG equipment for fixed installations. Fine-gauge Monel strainers withstand 600 psi . . . high temperatures . . . severe corrosive attack.

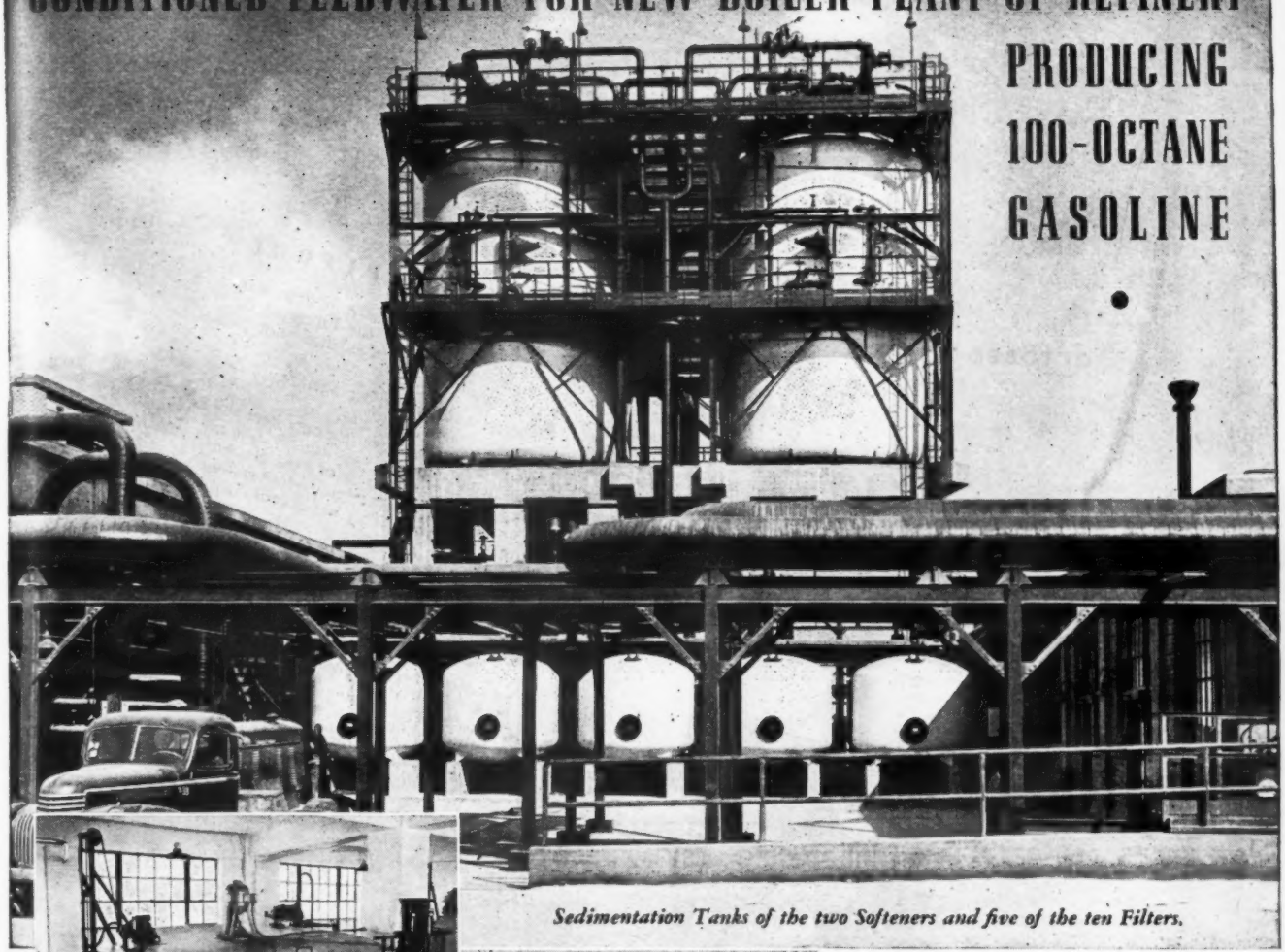
MONEL

NICKEL (INCO) ALLOYS

MONEL* • "K" MONEL* • "S" MONEL* • "R" MONEL* • "KR" MONEL* • INCONEL* • "Z" NICKEL • NICKEL • Sheet . . Strip . . Rods . Tubing . . Wire . . Castings . . Welding Rods (Gas & Electric)

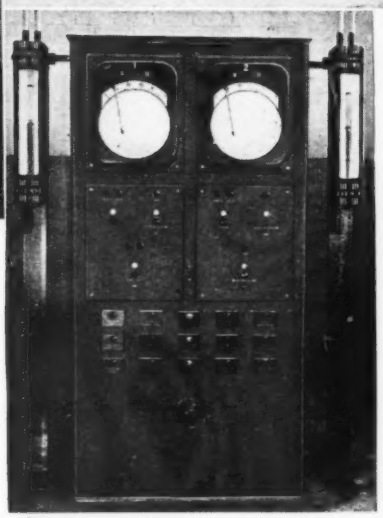
CONDITIONED FEEDWATER FOR NEW BOILER PLANT OF REFINERY PRODUCING 100-OCTANE GASOLINE

•



Sedimentation Tanks of the two Softeners and five of the ten Filters.

Above—Chemical Mixing Tank.



Right — Cochrane Flow Meter Panel Board for Automatic Control of Acid Feed.

AT one of the big California refineries now devoted to the production of 100-octane gasoline exclusively, the installation illustrated here, consisting of two 50,000 GPH, Cochrane Deaerating Hot Process Softeners, with ten 9′ dia. Filters, Mixing Tank, etc., supplies conditioned feedwater to the new high-pressure boilers. Many unique Cochrane features distinguish this installation, among which are a stirring mechanism which reduces turbidity to less than 5 ppm, automatic sludge blow-off, backwashing of filters with filtered water and panel board control of chemical feeds. • Write for complete details of this job or for a copy of Publication 3000, "Hot Process Softeners."

COCHRANE CORPORATION
A DIVISION OF AMERICAN ENGINEERING COMPANY

ARMY E NAVY

3106 N. 17th ST., PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

OCTOBER 2, 1941

WE RENEW OUR PLEDGE

Two years ago, at the beginning of the present war with its uncertainties and threats to the future of all industry, this Company publicly pledged itself not to increase its selling prices.

On this, the second anniversary, we again publicly renew that pledge.

During the last two years we have not only kept the pledge previously made, but *we have actually reduced our selling prices by more than* 6% because of more efficient operation made possible by the marvelous cooperation and ability of our organization. This was accomplished in the face of rising labor and material costs, both of which have been increased by considerable amounts.

It is our belief that the only hope for the continuance of the present industrial system now threatened from within and without is in its ability to give more and more to the consumer for less and less of his dollar. This is the strength of American individual initiative. This is the hope of our country's future. If American industry can accomplish this universally, we need not fear dictators either at home or abroad.

THE LINCOLN ELECTRIC COMPANY

J. F. Lincoln
President

Cleveland, Ohio
October 2, 1941

STATEMENT OF POLICY

The world is entering a crisis, the result of which no one can foresee. Other wars have brought inflation, followed by unemployment and depression after peace was achieved. America's experience in the World War illustrates this fact.

Much of this post-war trouble would have been eliminated by a more foresighted price policy on the part of manufacturers and distributors. Price inflation by the seller when he had a dominant position resulted inevitably in reaction with deflation, depression and suffering. Many of those price increases were not warranted.

Before such an inflationary cycle of prices is again started, we publicly pledge ourselves, as far as possible, to maintain present prices.

Further, if the materials we buy are increased in price, or the cost of labor is increased, then we pledge ourselves to raise selling prices no more than the bare increase in cost of raw materials and labor going into our products.

Further, we pledge ourselves to pass on to our customers the reduction in cost made possible by better manufacturing methods, wider distribution and technical advances in production.

THE LINCOLN ELECTRIC COMPANY

J. F. Lincoln
President

Cleveland, Ohio
October 2, 1939

OCTOBER 2, 1939

★ ★ OUR PLEDGE MAINTAINED ★ ★

On October 2, 1939, we announced the policy of "no increase in selling prices". A progress report made October 2, 1941, showed we actually had reduced prices by more than 6% during the period 1939 to 1941.

We have adhered to this policy of price reduction throughout the war years. Despite general increases in the costs of labor, materials and distribution . . . and despite governmental regulations . . . we have been able to maintain or reduce our prices throughout the entire period from 1939 to date.

This has been made possible by our incentive system . . . a method which, if it had been applied throughout industry, would have doubled America's output of war goods for a quicker Victory and would have cut the cost of the war by 50%.

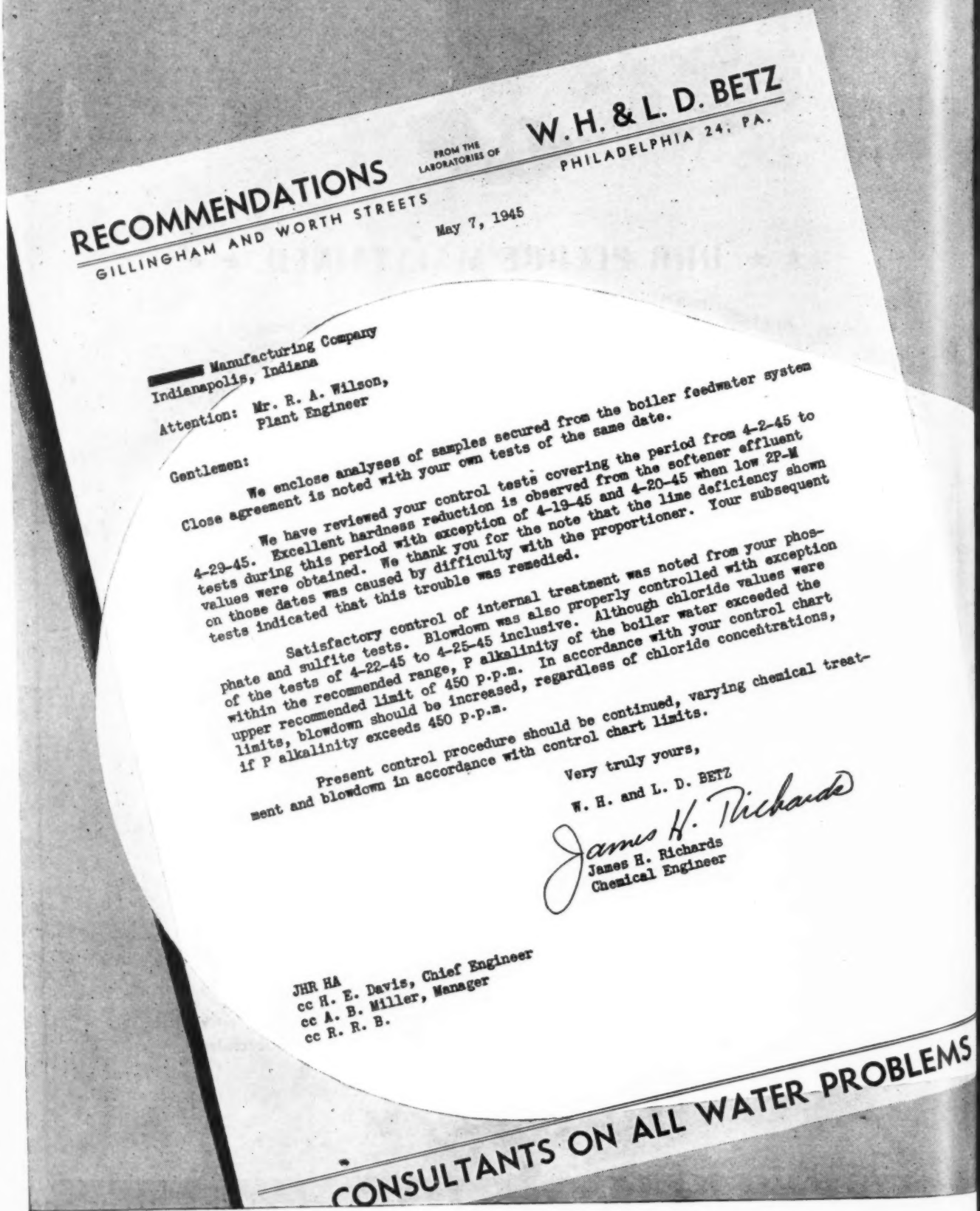
America's future depends largely upon her *efficiency of production.* Our proved incentive system has in it the seeds of a satisfactory answer to the difficulties of this nature in industry.

THE LINCOLN ELECTRIC COMPANY

Cleveland 1, Ohio
May 7, 1945
Victory in Europe

J. F. Lincoln
President

Why Betz Stresses *Engineering Guidance* in Boiler Water Control . . .



RECOMMENDATIONS

GILLINGHAM AND WORTH STREETS

FROM THE LABORATORIES OF W. H. & L. D. BETZ PHILADELPHIA 24, PA.

May 7, 1945

[redacted] Manufacturing Company
Indianapolis, Indiana

Attention: Mr. R. A. Wilson,
Plant Engineer

Gentlemen:

We enclose analyses of samples secured from the boiler feedwater system 4-29-45. Excellent hardness reduction is observed from the softener effluent tests during this period with exception of 4-19-45 and 4-20-45 when low 2P-M values were obtained. We thank you for the note that the lime deficiency shown on those dates was caused by difficulty with the proportioner. Your subsequent tests indicated that this trouble was remedied.

Close agreement is noted with your own tests of the same date.

Satisfactory control of internal treatment was noted from your phosphate and sulfite tests. Blowdown was also properly controlled with exception of the tests of 4-22-45 to 4-25-45 inclusive. Although chloride values were within the recommended range, P alkalinity of the boiler water exceeded the upper recommended limit of 450 p.p.m. In accordance with your control chart limits, blowdown should be increased, regardless of chloride concentrations, if P alkalinity exceeds 450 p.p.m.

Present control procedure should be continued, varying chemical treatment and blowdown in accordance with control chart limits.

Very truly yours,

W. H. and L. D. BETZ

James H. Richards

James H. Richards
Chemical Engineer

JHR HA
cc H. E. Davis, Chief Engineer
cc A. B. Miller, Manager
cc R. R. B.

CONSULTANTS ON ALL WATER PROBLEMS

The most important step in the boiler water control service furnished by W. H. & L. D. BETZ is the regular monthly report prepared by our Engineering Department and which is termed "Recommendations". This report is submitted directly to the plant.

A typical report is shown on the facing page. It should be noted that these "Recommendations" offer constructive criticism and advice where applicable and suggest changes in the control when necessary. In this manner the plant obtains the benefit of professional engineering supervision which is so essential for proper chemical treatment and control. This is a continuous close supervision which is coupled with the plant's own control applied thru a daily testing program which has also been established by our Engineering Department. Thus, as copies of the plant's daily test records are received by our Engineering Department, they are immediately reviewed by our Chemical Engineers and if any divergence from the established control is detected, the plant is notified at once. Otherwise, if the record appears to be in good order—that is, if the daily test records indicate the chemical balances have been properly maintained—this fact is confirmed to the plant in the regular monthly "Recommendations" report in the manner shown on the opposite page.

This comprehensive engineering guidance is the keystone of Betz Service. That is why we stress it to all of our clients. It is their assurance against unscheduled boiler outages which can so often result in costly production delays. A service such as this is a "must" in modern boiler plant operation.

W. H. & L. D. BETZ

Gillingham & Worth Sts., Philadelphia 24, Pennsylvania

THE 6 FUNDAMENTALS OF BETZ BOILER WATER CONDITIONING SERVICE

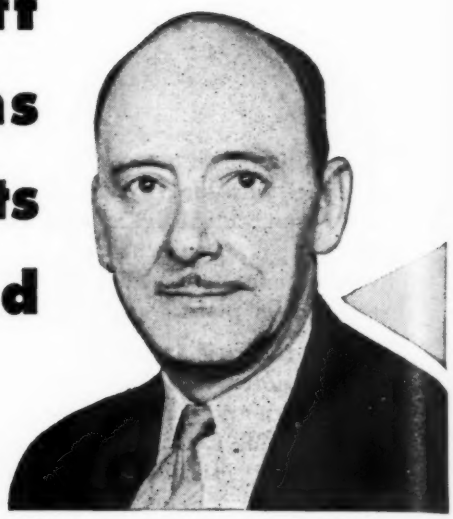
1. Complete plant investigation and report.
2. Establishment of plant control.
3. Daily plant control tests.
4. **Detailed review of plant tests and report.**
5. Supplementary complete laboratory analyses.
6. Periodic "check-up" visits.

No. 4 in a series of advertisements outlining the fundamentals of Betz service.

CHEMICAL ENGINEERS—
CONSULTANTS ON ALL WATER PROBLEMS

BETZ

"Electrical Surges at Shift Change Caused Shutdowns On Our War Loaded Circuits —But BUSS Fuses Cured Our Trouble."



Mr. V. R. LUNDQUIST, *Plant Engineer*
The Benrus Watch Company
Waterbury, Connecticut

"Ours was a typical plant expanding rapidly due to increased production for war," Mr. Lundquist explained. "All of our lines were loaded to near capacity. Then trouble started. Fuses in branch circuits were blowing as often as 5 or 6 times a week at shift changes. The sudden surges created in the lines when a battery of machines started simultaneously caused ordinary fuses to blow. Then, of course, the machines shut down and irreplaceable production time was lost.

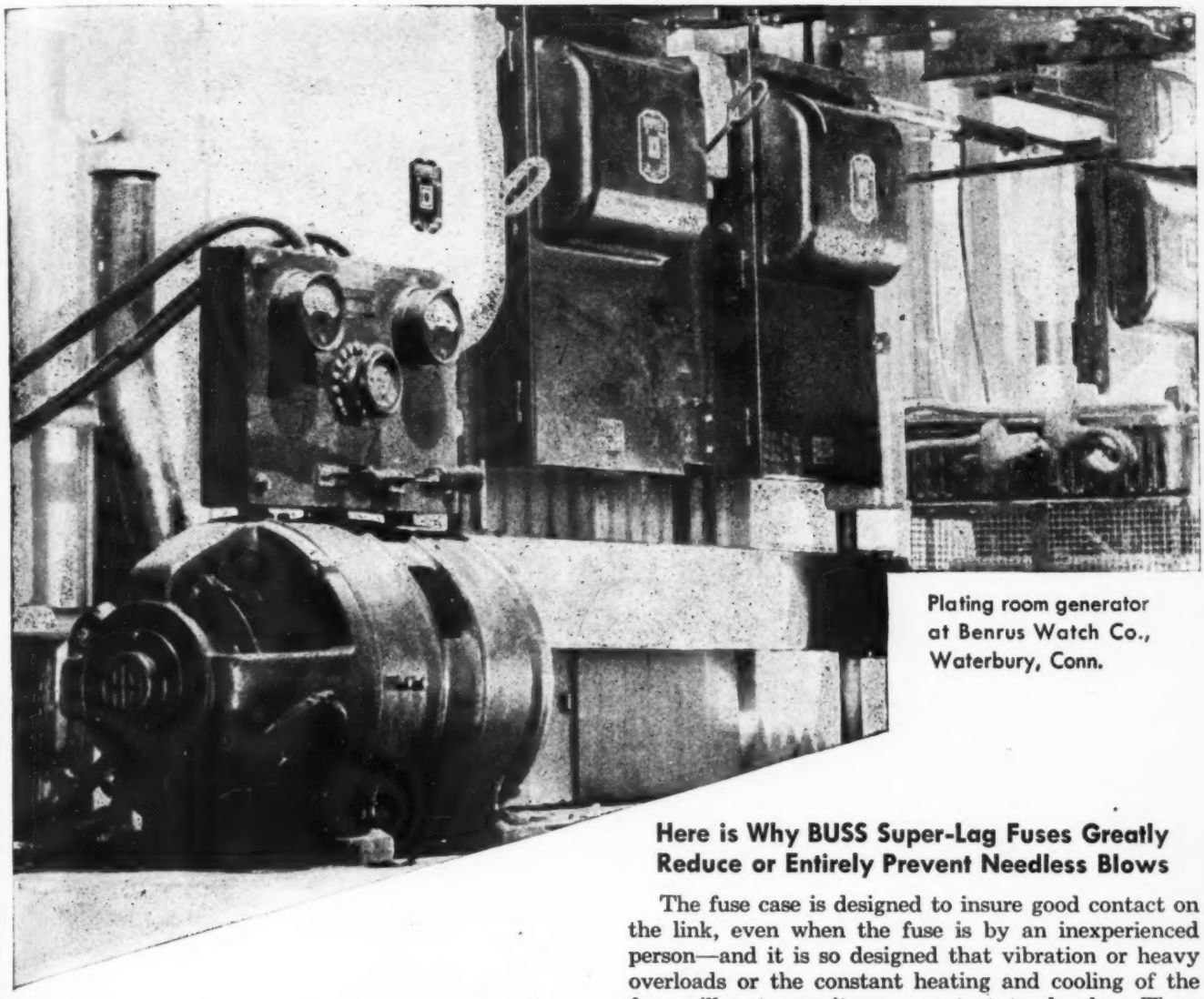
"About January, 1942, we installed Buss Super-Lag fuses in all circuits. The trouble was corrected immediately, and we have experienced no recurrence of this costly nuisance.

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possibe

and **The SUPER-LAG** development in the FUSE-LINK completes the job.

BUSS



Plating room generator at Benrus Watch Co., Waterbury, Conn.

You, too, CAN PROFIT BY STANDARDIZING ON BUSS FUSES

Mr. Lundquist's experience that led him to specify BUSS fuses at Benrus Watch Company is a typical reaction of men who have tried these fuses. It is proof that shutdowns caused by needless blows can be prevented—and adequate protection can be provided in the same protective device.

As for BUSS Super-Lag fuses—the experience of thousands of plants throughout all industry has proven time and again that by using them you can obtain trouble-free protection at a lower overall cost than with any other renewable fuse.

They require no maintenance or periodic inspection. They don't open needlessly. If one opens you know there is some fault that needs correction.

Here is Why BUSS Super-Lag Fuses Greatly Reduce or Entirely Prevent Needless Blows

The fuse case is designed to insure good contact on the link, even when the fuse is by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus, excessive heat which causes fuses to blow when they should not is prevented.

The fuse link used is the famous "BUSS SUPER-LAG." It has lag-plates attached which give it a long time-lag so that unusually heavy starting currents or other harmless overloads will not cause the fuse to blow.

And Here is How to Solve the "Shutdown Problem" in Your Own Plant

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses give.

BUSSMANN MANUFACTURING CO.
University at Jefferson, St. Louis 7, Missouri
Division McGraw Electric Company

Super-Lag FUSES SOLD THROUGH WHOLESALERS

What makes your town tick?

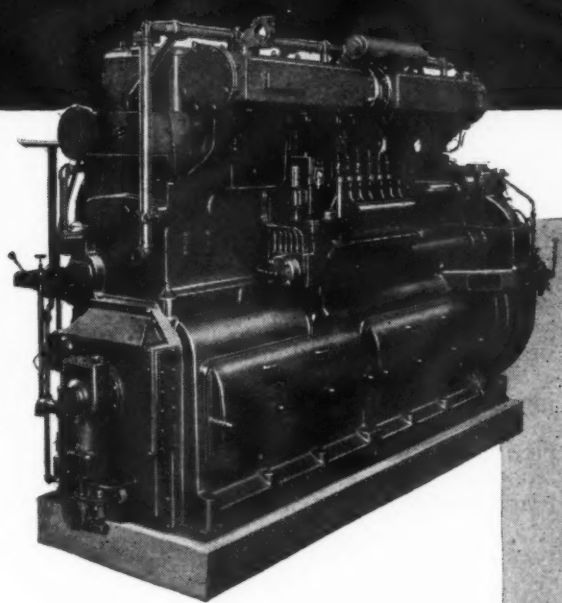
The answer, of course, is *power.*

Factories, offices and homes, today, are geared to dependence upon power. Power always available—instant and adequate.

That is the big advantage of ALCO diesel engines over many other types of prime movers. Their power is always available, always ready.

Other ALCO advantages are high capacity per unit of space—and weight. ALCO engineers pioneered lighter-weight, more compact, higher-speed diesel engines—proved that less weight and bulk could be combined successfully with higher engine power and greater durability.

More than a million and a half horsepower of ALCO diesel engines are in central stations, ships, oil-well drill-rigs, pumping stations, stores, hospitals, dredges, tugs, ferries, mines, mills and many other applications requiring dependable, economical power.

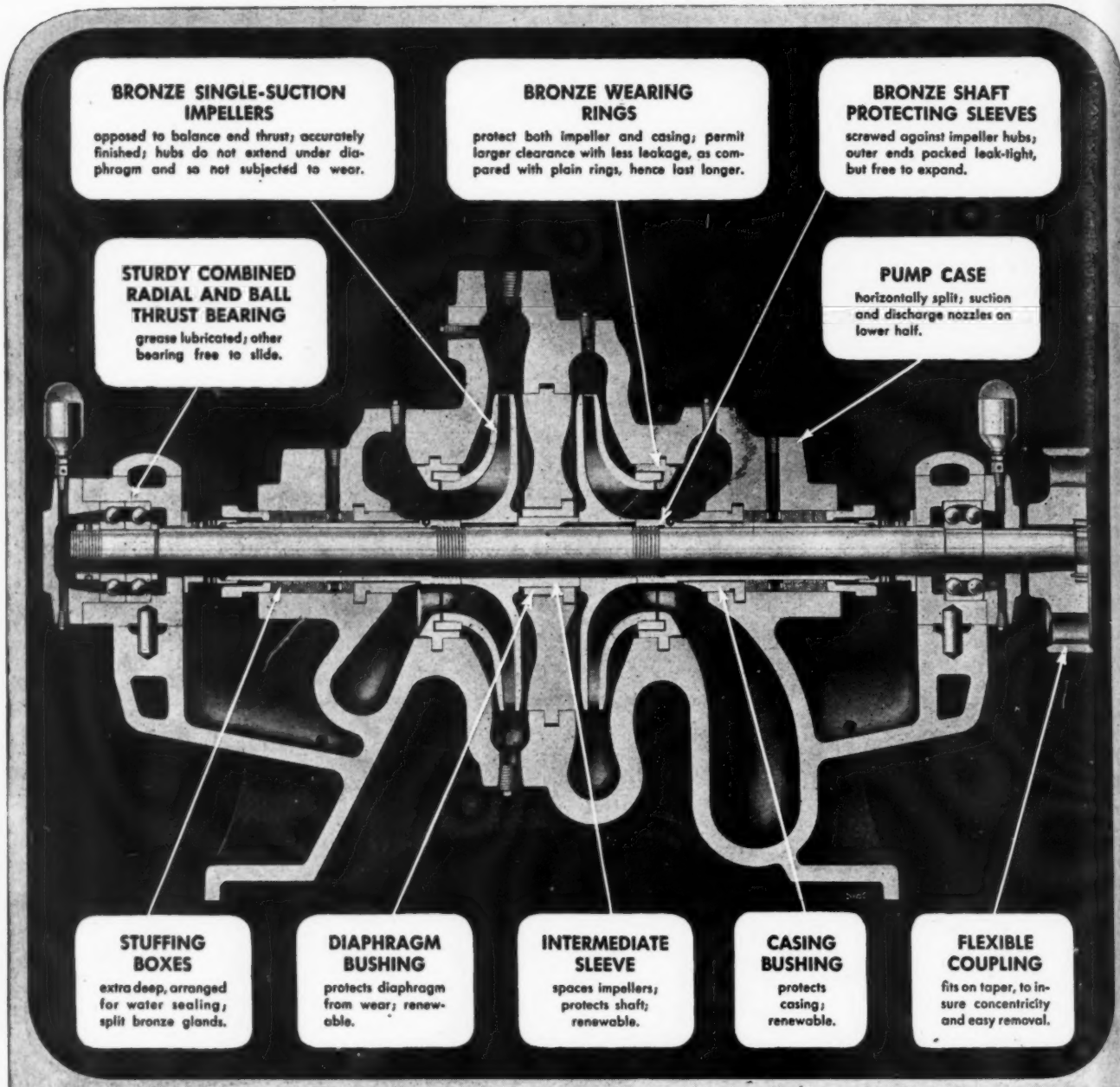


American Locomotive

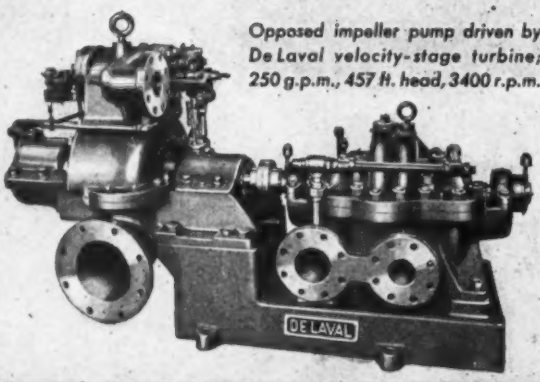
ALCO DIESEL ENGINES

For Universal Application

30 Church Street, New York 8, N. Y.


BRONZE SINGLE-SUCTION IMPELLERS
opposed to balance end thrust; accurately finished; hubs do not extend under diaphragm and so not subjected to wear.
BRONZE WEARING RINGS
protect both impeller and casing; permit larger clearance with less leakage, as compared with plain rings, hence last longer.
BRONZE SHAFT PROTECTING SLEEVES
screwed against impeller hubs; outer ends packed leak-tight, but free to expand.
STURDY COMBINED RADIAL AND BALL THRUST BEARING
grease lubricated; other bearing free to slide.
PUMP CASE
horizontally split; suction and discharge nozzles on lower half.
STUFFING BOXES
extra deep, arranged for water sealing; split bronze glands.
DIAPHRAGM BUSHING
protects diaphragm from wear; renewable.
INTERMEDIATE SLEEVE
spaces impellers; protects shaft; renewable.
CASING BUSHING
protects casing; renewable.
FLEXIBLE COUPLING
fits on taper, to insure concentricity and easy removal.

DE LAVAL *OPPOSED* IMPELLER PUMP



Opposed impeller pump driven by De Laval velocity-stage turbine; 250 g.p.m., 457 ft. head, 3400 r.p.m.

In this pump the two single-suction impellers have their suction inlets facing outwardly, thus balancing the pump hydraulically and requiring only two pairs of wearing rings. High efficiency is thus combined with simple construction. Pumps built in capacities up to 1500 g.p.m. and for heads up to 800 ft. Ask for Catalog P-3226.

DE LAVAL STEAM TURBINE CO. . . TRENTON, N. J.

J.

1945

WESTERN ELECTRIC CO.

POWER

JULY, 1945 VOLUME 89, NUMBER 7

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A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
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ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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Cover photo, courtesy Westinghouse Elec Corp.

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watch

THE CONTINUOUS ASH DISCHARGE AND YOU'LL SEE

Thorough combustion. No troublesome clinkers. No periodic dumping of ashes. Operating costs are held down. All these advantages because the Link-Grate keeps the fuel bed porous and lets low pressure air flow through the grates.

THE LINK-GRATE ADDS UP TO THESE 10 ADVANTAGES

- Permits use of low-cost fuel
- Effectively handles all types of loads
- Assures accurate control of air flow
- Fuel bed flow is unrestricted
- Prevents formation of objectionable clinkers
- Ash discharge is continuous
- Provides high reserve capacity
- Keeps operating costs low
- Simplifies control
- Keeps installation cost low

Westinghouse

PLANTS IN 25 CITIES . . OFFICES EVERYWHERE

LINK-GRATE STOKERS

WHY GIVE MORE STEAM PER POUND OF COAL

There is little unburned fuel in the ash discharge of a Westinghouse Link-Grate Stoker. Combustion is thorough.

Link-Grate motion maintains a regular combustion rate by continuously processing the fuel bed to keep it porous. Agitation at the rear of the stoker promotes a uniform flow of coal over the underfeed section and keeps the burning lanes open.

Grates first move up to break open the fuel bed and let low pressure air flow through the grates. The downward movement of the grates crumbles and conveys the burning fuel.

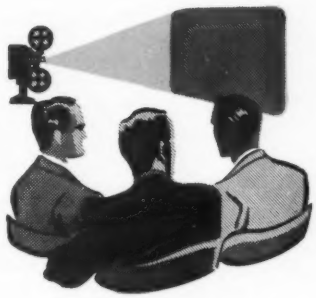
Positive movements of the fuel bed toward the ash discharge eliminates periodic dumping and reduces labor. Clinkers are no problem. Link-Grate motion prevents closed pores in the fuel bed and eliminates the cause of large clinkers.

Ability to handle all types of loads is another outstanding characteristic of the Link-Grate Stoker. It can meet suddenly increased steam demands quickly with full combustion efficiency because the fuel bed is always porous.

Before you make another investment in stokers be sure you have complete information about the Link-Grate. If possible, see one in operation. Your nearest Westinghouse office will be glad to arrange an appointment with a present user. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50462

SEE A LINK-GRATE DEMONSTRATION IN YOUR OWN OFFICE

Almost invariably, when a stoker buyer sees a Link-Grate in action he becomes a user. Realizing the difficulty that is often encountered by an individual or group in visiting a stoker installation, Westinghouse has prepared a new 15-minute 16 mm sound movie showing in detail the operation of a Link-Grate Stoker. Prints of this picture are available on loan for your private showing. Just address your request to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.



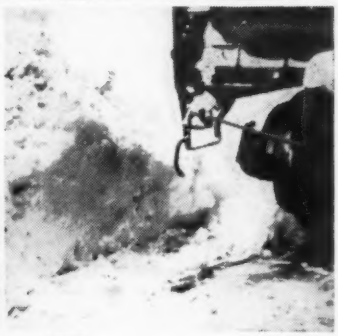
WESTINGHOUSE

Link-Grate STOKERS

Here's how BYERS SNOW MELTING

kept this plant's driveway *clear* last winter

Pipe coils of Byers Wrought Iron were laid on a sand bed with reinforcing mesh above, and topped with 6-in. of concrete. Supplemental mesh was placed above each coil.



First test came on November 30, when a considerable snow and freezing weather struck. This was followed by 45 inches of snow between Dec. 12 and Jan. 2.

•

In each storm, the installation speedily cleared the driveway. Users reported that within a few minutes after the snow stopped, the driveway was completely bare.

The heavy snows of last winter crippled many a plant by delaying material deliveries and hampering product shipment . . . and if yours was one of this unfortunate number, a new wrinkle used by the Hewitt Rubber Company at Buffalo, N. Y., may suggest a simple future defense.

A new driveway 12-feet wide and 80-feet long was put in last summer, with Byers Wrought Iron pipe coils beneath the concrete slab. The heating medium was exhaust steam at about 10-lbs. pressure. Coils were pitched so that the condensate would drain into a sump at the end of the drive. Plans called for continuous operation, starting about the first of November.

The winter provided a severe service test. During the 20-day period when 45 inches of snow fell, the thermometer never rose above freezing . . . and at times was down to zero, with a 45-mile wind blowing!

A similar installation, on a smaller scale, was made under a sidewalk at the Sarco Manufacturing Company plant at Bethlehem, Pa. Hot water was used as the heating medium, and completely satisfactory results were obtained.

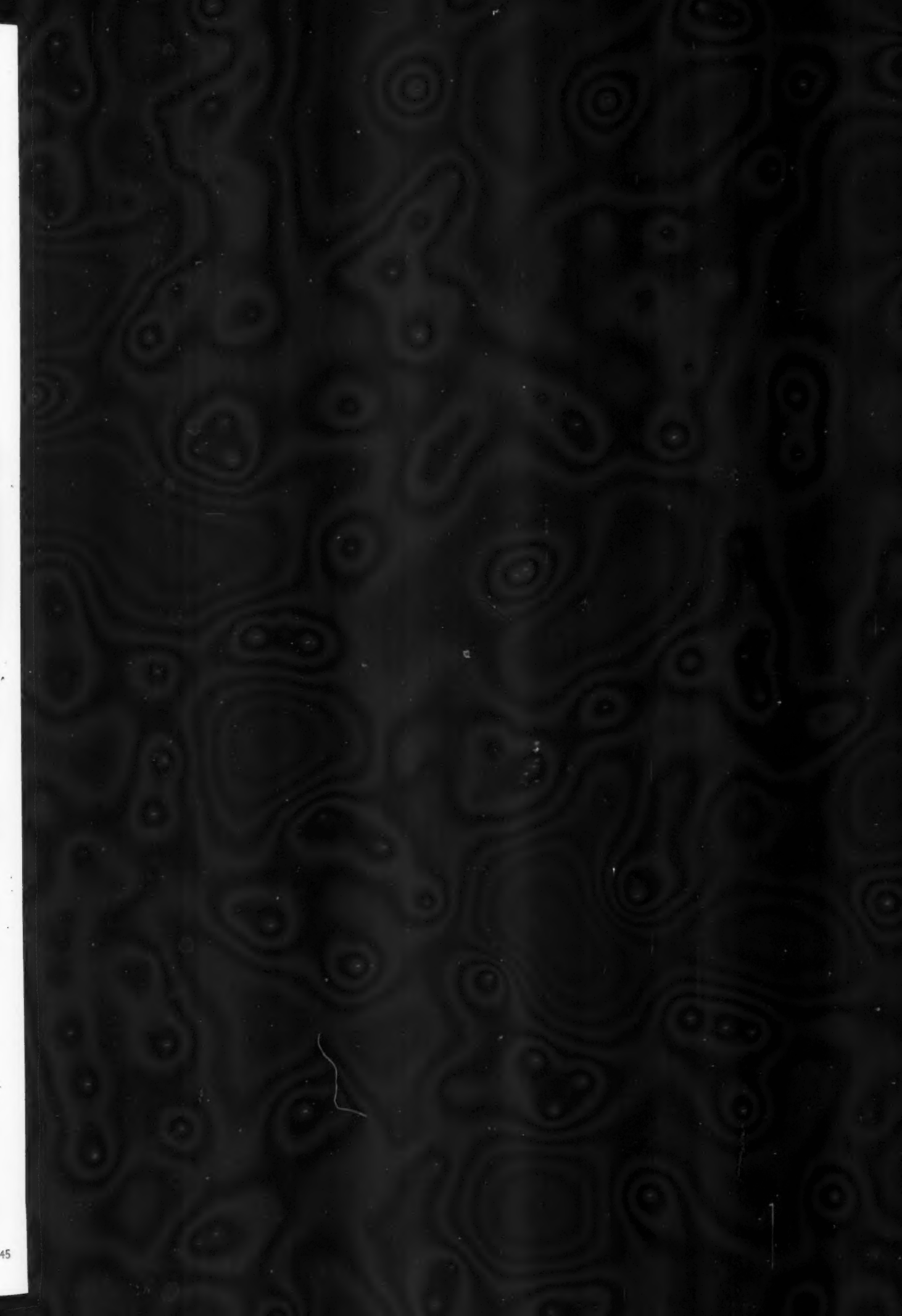
Obviously, these installations call for unusual corrosion resistance in the pipe. Byers Wrought Iron provides it. In hundreds of applications where it has been buried for years in the ground or embedded in concrete, its superior durability has been convincingly demonstrated. In addition, the material is easily formed and welded; it has high heat emission; and it expands and contracts at practically identical rates with concrete, which helps protect against thermal cracks.

We have just produced a Case History showing a "round-up" of several installations. If you would like a copy, just write.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

Corrosion costs you more than Wrought Iron

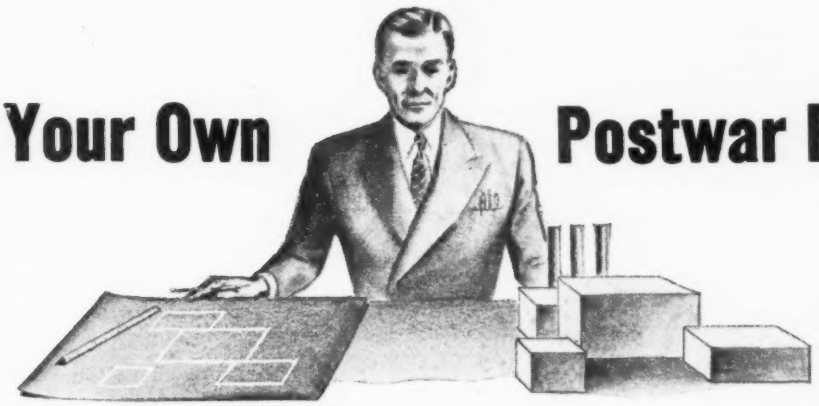
BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS



POWER

PHILIP W SWAIN, EDITOR • JULY 1945 • ESTABLISHED IN 1882

Make Your Own Postwar Plans



EVERY POWER ENGINEER must be his own postwar planner. Today, with Germany defeated and many buying restrictions removed from power equipment, the engineer should know exactly what's wrong with his plant and what it needs to make it right. This information should be on file in black and white—in writing, charts and drawings.

To know your plant and chart its future course is common-sense engineering. It also fits, hand in glove, the nation-wide drive of the Committee for Economic Development to get every responsible American working on his own private postwar plan. What the country needs, says CED, is not one master plan but thousands of practical private plans fitted to local needs.

The engineer will recognize this as sound advice. He knows that no central board could tell him what kind of a plant he should have.

Many power engineers completed their postwar power plans before VE day. For the rest the time is getting late because most items of power equipment can now be bought without priorities. There is no need to tolerate further waste and outages caused by overage, worn out machines.

Start planning with a study of the existing plant in terms of fuel costs, labor and service costs, dependability, etc. Then compare actual conditions with good practice. See what can be gained and what it will cost.

Planners must consider also probable future loads (electrical, steam, air, refrigeration, etc) because these will fix the number and kind of units, the pressure and the hookup. Here top management should be consulted to learn what are the business and production plans to which power plans must be harnessed.

Finally, remember that power equipment is a long-term investment. Oversights may be ruinous, so here are points no engineer planner can afford to overlook:

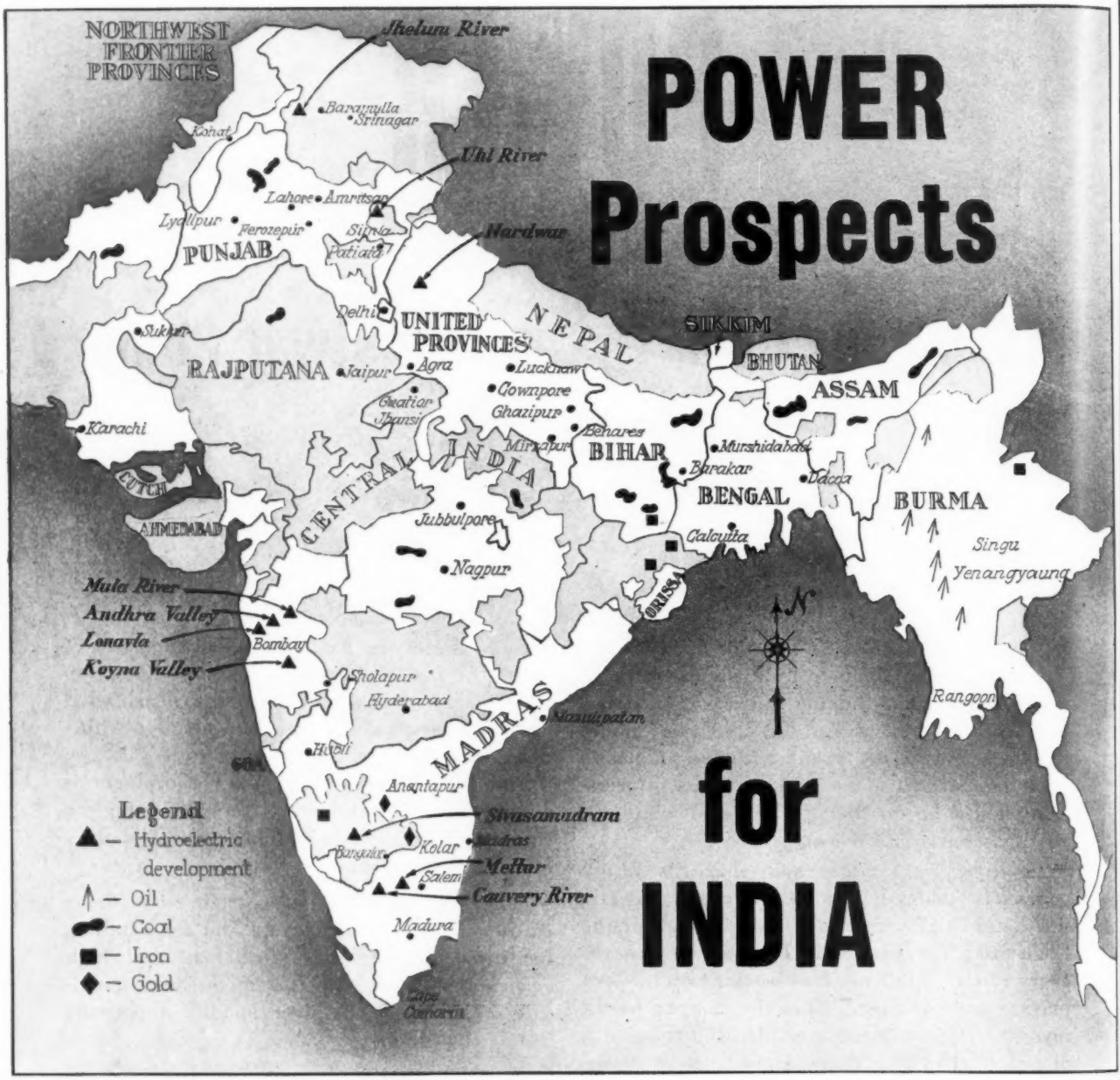
1—*Fuel versatility.* Make certain that firing equipment and furnaces, fuel and ash-handling facilities are ample for full load and high efficiency with any fuel that might be economically available in the given locality during the life of the plant.

2—*Smoke and dust.* Stricter smoke regulations are a postwar certainty. To protect your product, your workers, your company's good will and pocketbook, be sure the plant is designed to operate without smoke or excessive stack dust.

3—*Pressure and hookup.* When byproduct power is planned check hookup carefully. Be sure steam pressure is high enough to take care of power loads that may grow faster than process loads.

4—*Wages and fuel prices.* Evaluate operating ease and equipment efficiency on the basis of continued high wages and fuel prices.

5—*Flexibility.* No planner can foresee everything, so leave elbow room in your plan for future changes of mind to fit new and unpredictable business situations.



Postwar plans call for tremendous expansion of hydro and steam generation in one of the world's power-poorest areas. Robert C Cockburn, just returned from Calcutta, tells the story of India's power planning to John S G Shotwell

▶ INDIA APPEARS on most maps as a small triangular country in the south of Asia. Actually, it covers a territory almost as extensive as the U. S. If the map of India were overlaid upon that of the U. S., drawn to the same scale, Kashmir would correspond to Winnipeg, Canada; Cape Comorin would fall somewhere in Yucatan, Mexico; Karachi about Denver; Calcutta near White Sulphur Springs; and Rangoon between Charleston and Bermuda.

India's population of over 400 million are employed mostly in agricultural pursuits, barely scratching a living from the soil, whereas all industrial life is concentrated in a few areas, mainly in the presidencies of Bengal and Bombay and the Indian states of Hyderabad and Mysore. Thus, power production centers chiefly in these areas.

For many decades following its first contact with the mechanized West, India remained essentially an agricultural subcontinent of Asia, deriving both its sustenance and trading wealth from the products of the soil. During the latter half of the nineteenth century, several important innovations were brought about, notably the establishment of cotton and jute mills, but it was not until World War I that any general development and expansion of industry occurred.

During that war period, closing of the sea lanes combined with scarcities in Europe and other areas, of those

manufactured articles necessary for Indian well-being, brought home to Indians the danger of an isolated economy wholly dependent on the export of raw materials. The outbreak of hostilities in 1939 with the resulting destruction and consumption of so many commodities on an unheard-of scale further focused attention on India's industry. It has been faced with the task of not only making up the deficiencies in goods used by the civilian population but also furnishing a sizable portion of the war material necessary to repel Japanese incursions.

Coal, Hydro and Oil

Indian industry relies for its power on coal, hydro-electricity and oil. Following the fall of Burma, oil temporarily lost much of its value since the important producing fields were located in that area. Bringing oil from the Persian gulf was a long haul.

Geography and highly seasonal rainfall have also imposed certain limitations on Indian hydroelectric development. The larger rivers, such as the Indus, Ganges and the lower Brahmaputra, are broad, relatively shallow and sluggish streams that traverse very flat terrain unsuitable for power dams. Thus, the initial developments and, in fact, most of the developments are located in the Western Ghats, a minor mountain chain extending along the western coast. These supply such important centers as Bombay, Hyderabad and Bangalore.

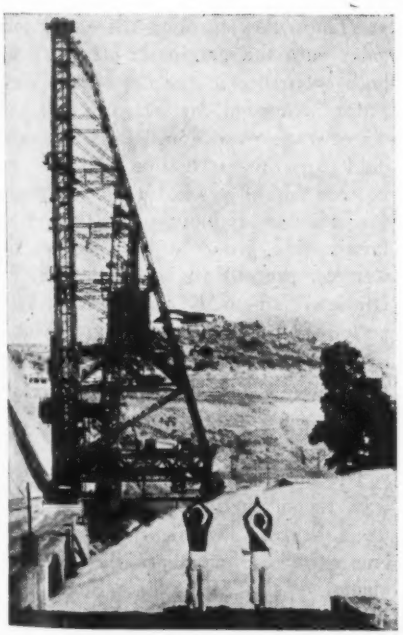


Fig. 2—The Cauvery is one of India's sacred rivers and is here being saluted as such even though the waters have come through the sluices of Mettur Dam

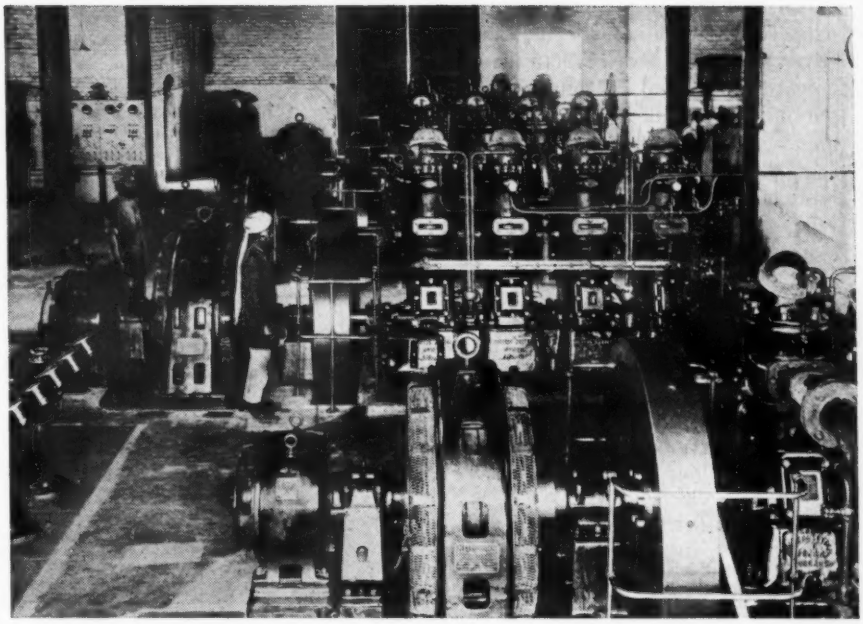


Fig. 1—Typical oil-engine plant is this station at Sulemanke. Three 240-hp units in the background, 60-hp set in front. Note low-tension switchboard at left

While several smaller plants have been established on the Jhelum and Swat Rivers and other Himalayan streams, they are not important from the industrial viewpoint because of the undeveloped nature of the northern areas.

Coal is the major source of power throughout India. The fact that the coal fields are in the central and northeastern portions of the country has had important bearing both on the placement of power plants and on industrial development. This trend is greatly accentuated by the location in the same general area of the richest and most extensive iron deposits.

Because of the shortage of rolling stock, this concentration of power and industry in the neighborhood of the coal fields has been of greater significance than in most other countries. The war in the Mediterranean forced the exportation of coal from India to that theater with the result that Indian power output was sharply curtailed, so much so that many jute and other factories were obliged to operate on a reduced scale and even such important utilities as ice factories were able to operate only sufficiently to supply hospitals.

While numerous small power plants are located in the non-industrial cities to supply them with electricity for domestic purposes and such utilities as ice plants, street railways and lighting, the main power production centers in the presidencies of Bengal and Bombay, containing the important ports and industrial centers of Calcutta and Bombay. Calcutta is not only the seat of the jute industry but also possesses numerous subsidiary industries, including silk and flour mills, tanneries, chemical plants, match factories, vegetable oil mills, etc, largely centered around the city itself. Being near the coal deposits of central India and Bihar and beyond the practical reach of hydroelectric transmission, this region relies primarily upon steam power.

Established with technical assistance from the U. S. is the famed Tata Iron & Steel Co, Ltd, at Jamshedpur, some 150 miles west of Calcutta. This plant shares the honor with Newcastle in Australia of being the largest steel works in the British Empire. The Tata family not only control the iron and steel industry but also founded and built the hydroelectric system of western India.

Textile Industry

Bombay, together with Ahmedabad, contains the bulk of the cotton and textile industries, today supplying not only the country's civilian needs, but a considerable portion of the clothing requirements of the Indian army and the armies of the United Nations fighting on various fronts. Unlike Calcutta, these centers are able to avail themselves of the hydroelectric power from the various plants in the Western Ghats.

Mysore and Hyderabad have become important suppliers of planes, munitions and other chemical and mechanical products. These states possess suitable sites for hydro power, some of

which have been developed. Continued expansion and additions to the Cauvery River project in Mysore State have increased its original capacity more than tenfold. This plant is situated at Sivasamudram and transmits power over some 92 miles to the mining companies in the Kolar gold fields.

The majority of the Indian power systems are state sponsored, the principal exception being those owned or controlled by the Tata group and serving the Bombay area. All installations in the states of Mysore, Hyderabad and Kashmir are operated under state auspices. The remainder are operated by the Government of India under British direction.

Industrial Power

As a result of the complex setup of the country and the widely dispersed industrial conditions, most of the steam and oil installations are owned and operated by the individual plants using their power. For this reason, networks for power transmission are lacking and the voltages extremely diverse.

This diversity of ownership makes it difficult, even in normal times, to estimate Indian power output based on coal and oil. War conditions have profoundly affected both resources. The requirements for coal abroad as well as strained railway facilities have particularly affected power production. In previous times oil found its widest use for power in Madras and South India, and by one or two of the railway systems. Loss of the Burma fields made many conversions and improvisations necessary, especially since the only large producing field in India is in the extreme northern part.

The Ganges and the other large Indian rivers, as mentioned previously, are not particularly suited for hydroelectric development because they flow through relatively level country and the rainfall is confined to the brief monsoon. However, at Hardwar, on the Ganges some distance from Benares, a hydroelectric system has been built in conjunction with a large irrigation scheme as a combination development.

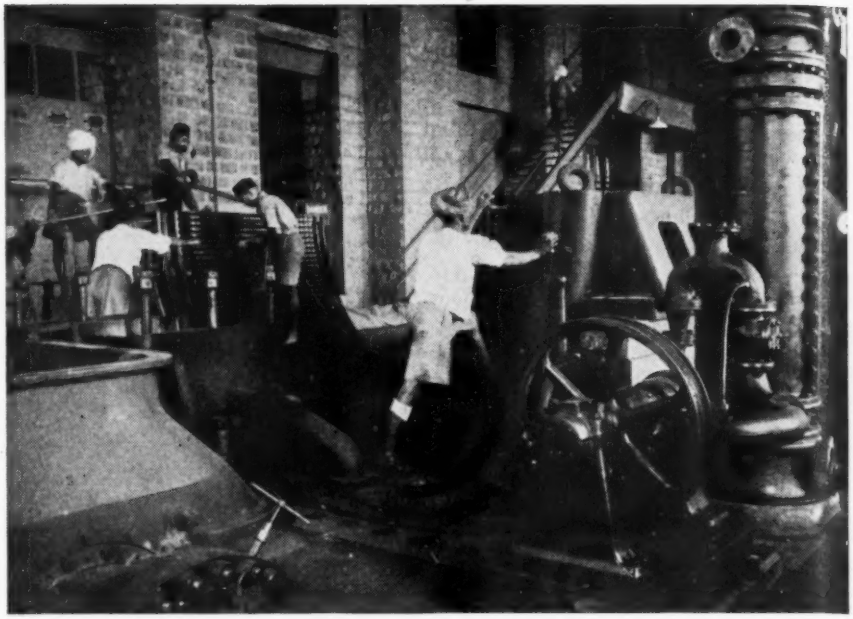


Fig. 4—Getting ready to rewind lower half of a generator in place requires hand labor of many men. Note varied head dress and bare feet of typical laborers

The power station itself is not large, being approximately 30,000 kw, but the cost of electricity is low since the main capital costs of the project are assessed to the irrigation works. Thus, the expense of dams, reservoirs, diversion weirs, tunnels and pipelines was not charged to electrical power. The water is supplied to the power plant by a large irrigation canal and the water discharged from the tailrace is also used for irrigation. A further advantage in the setup rests in the fact that the maximum flow through the canal coincides with the maximum electric load, both occurring in the hot season when water is needed for irrigation.

For many years religious obstacles held up this irrigation system, important though it was for the well-being of India in reducing the danger of famine. In order to be effective, the Ganges, that "Holy of Holies" to the Hindus, had to be dammed and diverted—a sacrilege. It required much time and diplomacy to overcome the religious aspects.

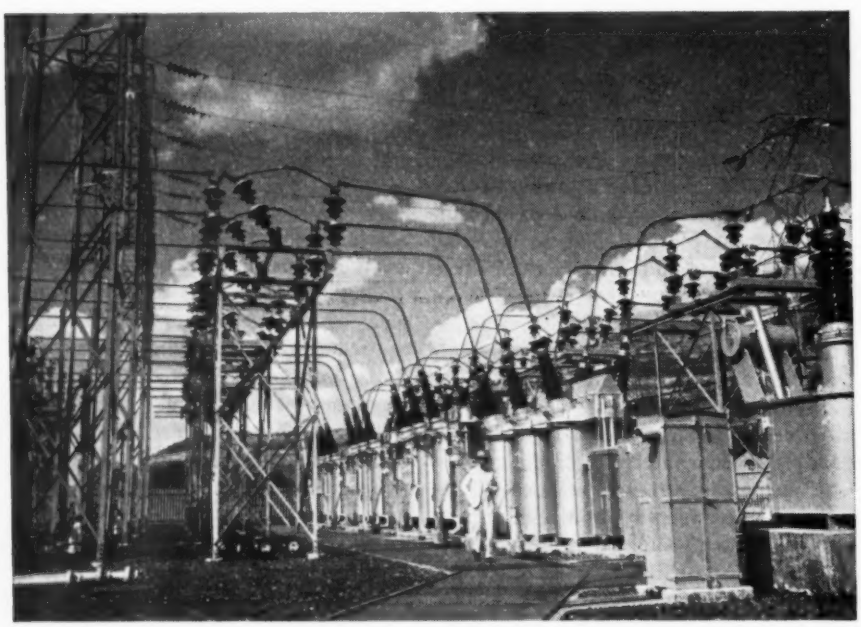


Fig. 3—Superintendent of a generating station inspects his modern switchyard

Postwar Planning

The government of India in its postwar reconstruction planning, has set up a central Technical Power Board, one of whose members has been an official of the TVA. This Board is to initiate, coordinate and promote schemes for electrical development throughout the country and to encourage the use of electricity by education and propaganda. It has also

Fig. 5—Constructing a sluice for headrace canal of a hydro project in Mysore, one of India's most progressive states

Fig. 6—Penstocks lead down the rugged hillside from hand-built stone structures, typical of most construction in India

adopted a policy of expanding industrial use of electricity, particularly in the manufacture of fertilizers that are so badly needed generally in agriculture.

India is the very last among the large nations of the world in the use of electricity. Whereas the annual consumption of electricity per capita in the U. S. is about 2000 kw hr., the equivalent figure for India is 5 kw hr per person. This explains in large measure why development of electricity and its proper utilization occupy a prominent place in Indian policy. It has been estimated that the potential water resources of India amount to 27 million hp. Present installations develop only in the neighborhood of 600,000 hp.

A recent conference of leading Indian power engineers, to consider the postwar electric power development, set up a program calling for the investment of about 150 million dollars in central power-plant equipment. This represents new capacity aggregating approximately 65% of the existing installations. The conference admitted that Indian needs call for a far larger expansion than is at present proposed, but it felt that a start must be made and that the above was the minimum that could logically be considered.

A recent investigation by John L Savage, U. S. Bureau of Reclamation, disclosed six potential hydroelectric sites, five in Punjab and another in United Provinces on a tributary of the Ganges. The Punjab development would total 750,000 kw and entail extensive irrigation. At Toms River, a heavy-arch concrete dam, perhaps higher than Boulder's 730 ft, might be constructed. Chami damsite on the Giri River resembles TVA's 500-ft Fontana concrete dam. Bhakra on the Sutlej River would need a dam about like that of 600-ft Shasta. Larji on the Beas River would be another Boulder in size, as would Dianghar on the Chenah.

All of these, in Punjab, would primarily be built for irrigation with some flood-control benefits and navigation as well as power. Substantial power would be available for purposes other than water pumping.

Ganges Tributary

A 600-ft dam at Nayar in United Provinces is believed to have been approved for construction soon after the War. A tributary rather than the main stream was chosen as the site because of extreme variations in the Ganges flow and because another potential location would have flooded out a particularly sacred temple.

This postwar planning is primarily hydroelectric development but the huge, incompletely developed coal fields have not been overlooked. Postwar plans for the expansion of steam power in those areas where hydroelectric power is not feasible are also being set up. Large central stations of the most modern design will be built.

Indian industry can manufacture much of the equipment required for this postwar expansion, but a great deal will have to be imported. Indian manufacturing facilities are now overloaded in the manufacture of war materiel and shipping is still too critical to consider the transportation of such large quantities of bulky material until the cessation of hostilities even if equipment could be obtained immediately.

HYDROELECTRIC DEVELOPMENTS OF INDIA

Name	*Location*	*Kw*	*Ownership*	*Area served*
Bombay Hydro-Electric Works, Ltd	Western Ghats	183,000	Private	Bombay & suburbs, Thana, Kalyan, Greater Poona
Mysore Hydro-Electric Works	Cauvery River	47,000	Indian state	Mysore, Bangalore and 200 towns and villages
Under Construction		35,000		
Madras	Pykara Mettur Papanasam	24,900 17,000 28,000	Gov't of India	Madras presidency
Kashmir	Jhelum River	15,000	Indian state	Srinagar and Baramulla
United Provinces Works	Hardwar	29,700	Gov't of India	75 towns and irrigation works
Punjab Hydro-Electric	Uhl River	12,000	Gov't of India	Amritsar and Lahore
Under construction		118,600		Ludhiana and 19 other towns

Electronic Maximum-Demand Controller Saves $2400 a Year

When maximum-demand peaks boosted electric-power bills so that they were unreasonably high, A R Wismer and his associates in the electrical maintenance department of a Canadian plant designed an electronic demand controller that reduced power costs $200 a month

▶ Many power contracts have a clause that penalizes the customer if monthly demand exceeds a given amount. Other contracts increase the power rate as the ratio of maximum to average demand increases. Either way, if monthly maximum demand can be decreased without interfering with production, operating costs will decrease.

To determine whether a maximum-demand controller is justified, make a graph of power demand for a given period and observe how frequently maximum demand occurs, how much it exceeds normal demand, and its duration. Usually you can plot this graph from the power company's graphic-demand-meter record; or, from an indicating-demand meter, take readings at suitable intervals to plot the curve. Also determine the load that can be dropped temporarily to control maximum demand without interfering with production. Frequently the power of electric furnaces, heat-treating tanks and the like can be interrupted for a short time without detrimental effects.

Power Load Studies

When we made these studies of the power load in our plant, only one or two peaks occurred each month. Our dural heat-treating tank would maintain its temperature within a minimum safe value for about 15 min with all power cut off. Also, a 75-kw furnace could be disconnected from the power line for some time without affecting production. We therefore decided to install a controller to cut off these loads automatically in three steps as the load approached the contract demand and to connect them as the peak receded.

Previous experience with contact-making instruments indicated that we needed a more reliable method for producing the initial impulses to the maximum-demand control relays. Therefore we used photoelectric tubes.

As shown in Fig. 4, the controller instrument is a polyphase indicating demand meter. This meter has a 15-min time interval. To have the meter actuated by total plant load its current coils are connected in series with the trip relay coils and current transformers for the main feeder switch. Potential coils of the meter connect to the 440-v power supply through potential transformers.

We extended the meter's pointer so that it covers a small hole drilled in three adjustable slides bolted to the meter's face. Three 7-v 15-w projector lamps are mounted in aluminum tubes, each with two plastic lenses to focus their light in a beam. These beams shine through the holes in the adjustable slides and slots cut in the meter

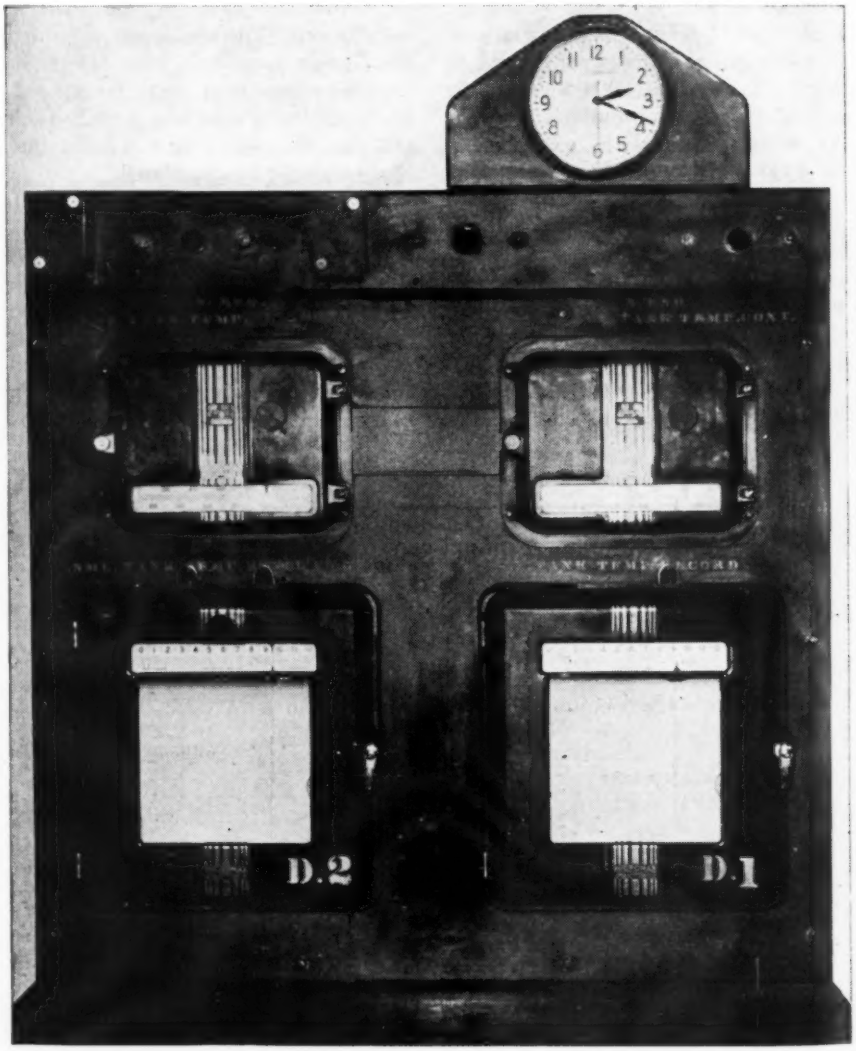


Fig. 1—Two relays in panel above dural heat-treating-tank control and meter board cut power off in two steps if maximum demand exceeds predetermined values

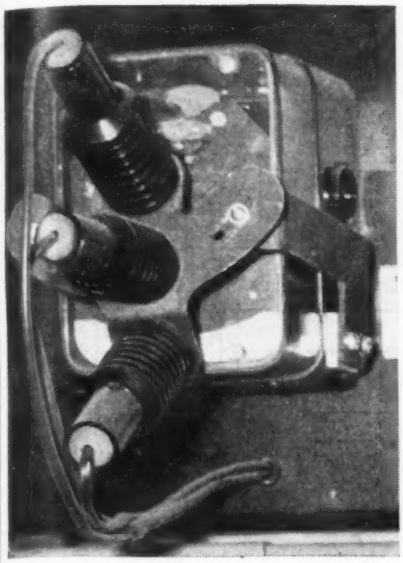


Fig. 2—Demand-indicating meter with photoelectric tubes and projector lamps

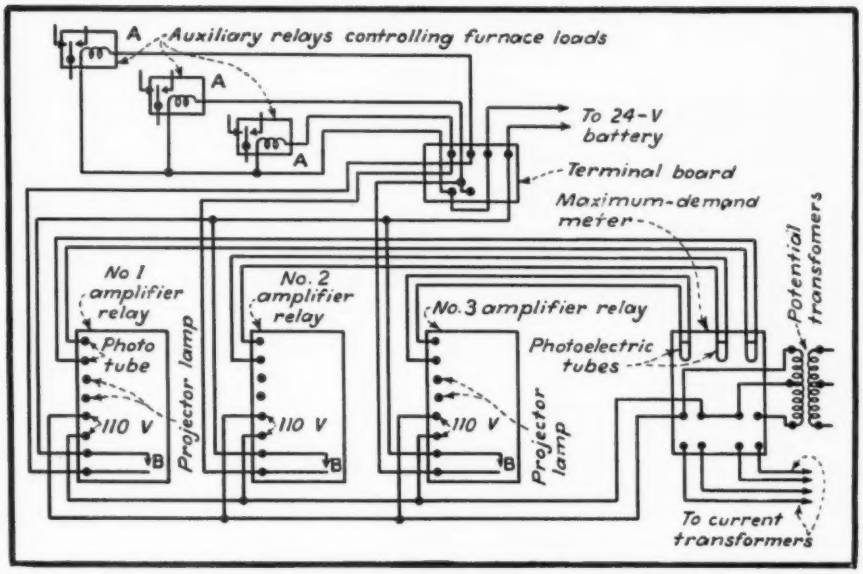


Fig. 4—Wiring diagram of maximum-demand-meter and electronic amplifier-relay assemblies, Fig. 3, and the auxiliary relays controlling maximum demand, Fig. 1

face to strike the cathodes of three photoelectric tubes mounted behind the meter face. We mounted the complete assembly on a bracket and fastened it to the meter base, as in Fig. 2 and 3. In this assembly each photoelectric tube can be separately adjusted.

Light beams are so arranged that as the pointer moves upward across the scale it cuts off the upper beam first, then the center one and finally the lower one. This gives the meter control of the three photoelectric tubes to provide three stages of load control. As shown in Fig. 4, each photoelectric tube has its own amplifier and relay. Each relay's contacts *B* are in series with a 24-v substation control battery and an auxiliary relay coil *A* at the loads. Fig. 1 and 3 show how relays *A* are mounted above electric-furnace meter-and-control panels to disconnect these loads if demand exceeds the set amount.

Amplifier-Relay Operation

As long as the light beam falls on the tube cathodes, amplifier-relay contacts *B* remain closed and energize the auxiliary relay coils to hold their contacts closed. When contacts *B* are closed, the loads they control remain on the line unless intentionally disconnected.

If the load increases above a predetermined demand, the demand-meter's pointer comes into the light beam on the first photoelectric tube. This action causes No. 1 amplifier-relay contacts *B* to open and disconnect a 75-kw electric furnace, which can be off for 15 min without seriously affecting production. If the load continues to increase, the demand meter's pointer interrupts the second light beam and No. 2 amplifier relay opens its contacts to cut off one half the power to a 240-kw dural heat-treating tank.

Should the load increase to where the demand meter's pointer cuts the third light beam, No. 3 amplifier drops the other half of the dural heat-treating-tank load. Covers on this tank assist in holding the heat so that it also can be cut off from the power supply for 15 min before its temperature drops below a safe minimum.

Fig. 5 and 6 show the circuits for one amplifier relay, which includes a photoelectric tube *P* and an amplifying tube *T*. When the transformer secondary has the polarity in Fig. 5, anode of amplifying tube *T* is minus and it does not conduct. Center transformer section supplies heating current to the cathode heater. The left-hand transformer section makes the photoelectric-tube anode minus and this tube also does not conduct. This transformer section has a closed circuit through resistor *R*, as indicated. It also applies potential from cathode *C* to grid G. The latter acting as an anode permits the transformer to charge condenser *O* to give it the polarity shown.

When transformer polarity reverses, as in Fig. 6, with the light beam on photoelectric tube's cathode, the tube conducts. Condenser *O* therefore discharges through this tube and the left-hand section of the transformer. Because condenser *O* can discharge through tube *P*, minus potential on control grid *G* drops so low that tube *T* conducts. This circuit is from the right-hand transformer section through tube *T*, the relay coil and back to the transformer to close relay contact *B*. At the same time condenser O_1 is charged to give it the polarity shown. When the transformer polarity reverses, condenser O_1 discharges through the relay coil to prevent its contacts chattering when tube *T* is not conducting.

If the light beam on tube *P* is interrupted by the demand-meter pointer, this tube cannot conduct and condenser *O* makes grid *G* sufficiently minus to prevent tube *T* from conducting. Relay contacts *B* then open to drop some of the load, as previously explained. When

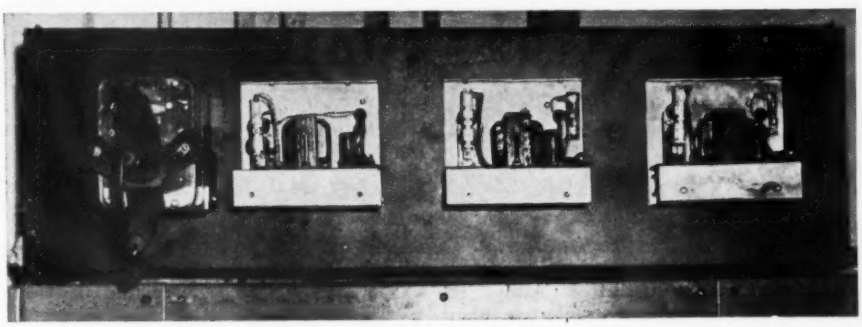


Fig. 3—Indicating maximum-demand meter with photoelectric assembly on the left and the three electronic amplifying relays mounted above main power switchboard

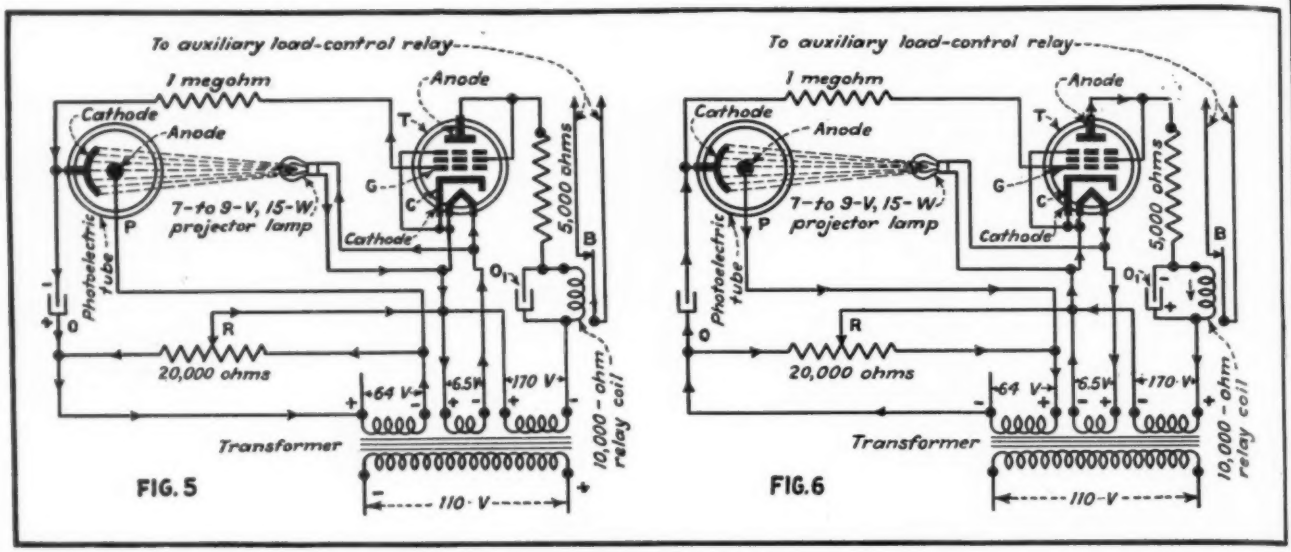


Fig. 5 and 6—Wiring diagrams of maximum-demand-meter photo-electric assembly and one amplifying relay. Circuits are indicated for both directions of current flow in the 110-v ac power-supply system, and functioning of equipment is shown

the power peak drops to normal, demand-meter pointer moves back out of the light beam and tubes *P* and *T* again conduct and relay *B* closes its contacts to switch the load back into service. Each of the three amplifier relays is similar to Fig. 5 and 6 and operates in the same way.

This maximum-demand controller has been in operation for over one year without failure, requiring no attention other than setting the cutoff points each month. A change in setting of these points is necessary because plant load and maximum demand changes from winter to summer. We have not had a projection lamp or an electron-tube failure, which is probably because of the comparatively low voltage on them.

The cutoff point was quite difficult to set because production interference could not be tolerated. We found that highest power demands occurred about 10 a m on dull days when all lights were in use and we therefore made our adjustments at that time. This controller will not limit maximum demand to a definite value unless it controls total plant load. Otherwise, the demand varies inversely with the percent of load controlled. The controller is also affected by the amplitude and rate of increase of load surges. Comparing demand-power costs before and after installing, we are making a saving of about $200 per month.

Russia Restoring Dneiper Hydro Station

Retreating before the Red Army, the Nazis completely wrecked the Dneiper hydroelectric plant, as shown at left. The dam did not suffer as severely as the plant, damage being confined chiefly to blasting away some gate piers, as at the right. According to I Kandalov, chief engineer for station restoration, the Germans also wrecked the highway bridge across the dam, carried off all electrical equipment, demolished cranes and blew up a 4-story control building. Photos show crews restoring dam and powerhouse. Equipment for the latter is being built in this country. *Photos, courtesy Sovfoto*

Put the Trap Where Air and Condensate Collect

Accumulations of air and condensate interfere with free steam flow, prevent complete heat transfer and lower the efficiency of steam-heated machines. Before a heating unit can function properly, it must be equipped with an automatic trap that is suited to the particular job

By R L CLARK
Strong, Carlisle & Hammond Co

▶A STEAM TRAP'S principal purpose is automatic removal of air and condensate from steam-heated equipment and distribution lines. Obviously, without some means of draining, steam equipment subject to heat loss would eventually fill with condensate. Suppose we used a globe valve for a drain and opened it exactly enough to drain out all water without releasing steam. It would: (1) discharge condensate as it accumulates (2) hold back steam (3) vent air (always present in varying amounts).

Principal objection to the globe valve is that it must be readjusted for every change in pressure or condensation rate or it will hold back condensate at heavy loads and leak steam at light loads. The automatic steam trap is a mechanical device that discharges the condensate and air, yet holds back the steam—all *under reasonably varying pressures and condensate loads.* Steady condensate load is a relative matter because even the so-called steady condensing rate of heating lines varies with steam pressure and warm-up time. Therefore, steam-trap selection resolves itself into determining the heaviest condensate load, the pressure under which it occurs, and which trap has sufficient capacity under these conditions.

Steam traps are of two types:

(1) Return or pumping traps used to (a) return condensate to the boiler against boiler pressure (b) discharge condensate against a static head or pressure greater than the line being drained, Fig. 1C.

(2) Nonreturn or separating traps that separate condensate from the steam or other medium by buoyancy (ball-float, open bucket, inverted bucket), tilting, thermodynamic or thermostatic units. Details are as follows:

(a) *Ball-float* trap uses a floating ball that rises and falls with the condensate level to open or close the discharge valve, Fig. 1G. It is also called a continuous-flow trap because condensate level within the trap causes the float to accommodate itself to the inflow rate and to discharge condensate continuously.

(b) *Upright* or *open-bucket* trap controls discharge-valve movement by the weight of water in an open bucket, Fig. 1A. Condensate gradually fills the trap body and overflows into the bucket. When the bucket becomes overbalanced it drops and pulls the discharge valve open, which permits water and air to discharge by pressure in the line. Trap valve is closed when sufficient water is

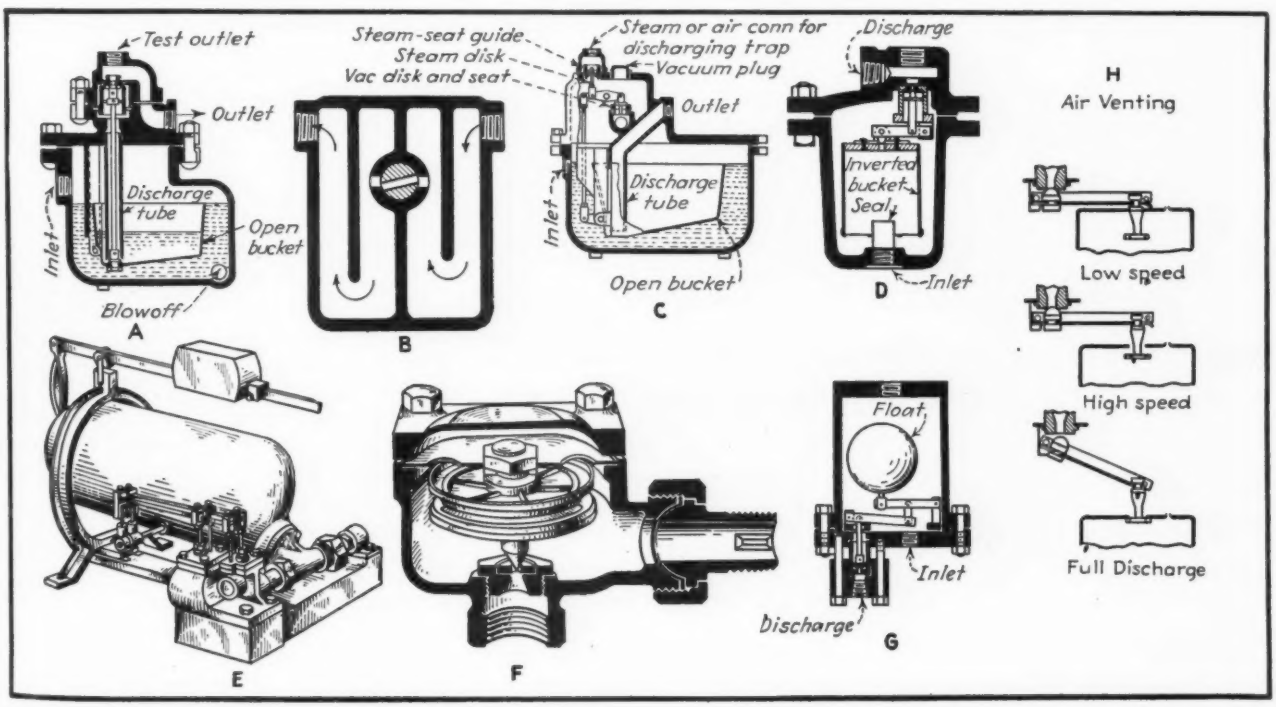


Fig. 1—There is a correct trap for every job but selection must be based on peak as well as normal load, amount of air to be vented, differential pressure across the trap and whether discharge is to be intermittent or continuous flow

discharged from the bucket to make it buoyant again.

(c) *Inverted-bucket* trap operates on the ability of the bucket to float when it is partly filled with air and steam, and to sink when water displaces the steam and air, Fig. 1D. In sinking, the bucket pulls the discharge valve off its seat and the trap discharges until entering steam and air cause it to become buoyant enough to close the valve.

Tilting Trap

(d) *Tilting* trap operates an external discharge valve through levers. The entire trap body is counterbalanced and when sufficient condensate collects in the chamber it overcomes the counterweight and the trap tilts, thereby opening the discharge valve, Fig. 1E. After condensate is forced out, counterweight tilts the body back to filling position.

(e) *Thermodynamic* trap controls condensate flow by the principle of condensate temperature regulating the flow rate through the discharge orifice, Fig. 1B.

(f) *Thermostatic* trap has a discharge valve that is actuated by temperature. Temperature affects a bellows, Fig. 1F, diaphragm or bimetallic strip.

Always select a separating trap for a particular installation on (1) combination of initial and maintenance cost (2) economy with relation to steam loss (3) ability to handle air and condensate load under pressure conditions encountered. Trap manufacturers make specific recommendations for their products, but careful study of trap literature is the best way to learn operating characteristics and features of each particular type.

After selecting the type of trap give careful consideration to capacity, which has little relation to pipe size or physical dimensions. One type of ½-in. trap may discharge 200 lb of condensate per hr at a given pressure while another of same pipe size discharges 2500 lb under the same conditions. One trap may weigh 4 lb, another 40 lb, while both have ½-in. connections. Trap capacity is determined by the unrestricted area of its discharge orifice. All reputable manufacturers furnish information on orifice sizes and capacities at various pressures.

While valve-orifice area is one of the best means of comparing trap capacity, the effect of different internal designs, types of orifices, flow restrictions at the orifice, valve mechanisms, piping arrangements, air pockets, and pressure drop can easily reduce condensate flow through a trap to a fraction of its theoretical orifice capacity.

Mechanical traps use different-area valves and seats for different pressures because the valve must come off its seat even though subject to line pressure. The manufacturer sizes valves, and he must know the operating pressure. Remember that a trap will operate on differential pressures lower than the seat-orifice rating (with decreased capacity) but cannot open against higher differential pressures. Thus, a trap with a 125-psi orifice may be used on differential pressures up to this value, but will not open on higher differentials. Actual pressures are determined by subtracting the discharge pressure (at trap) from inlet pressure (at trap). It is this differential, or operating pressure, that controls the orifice capacity.

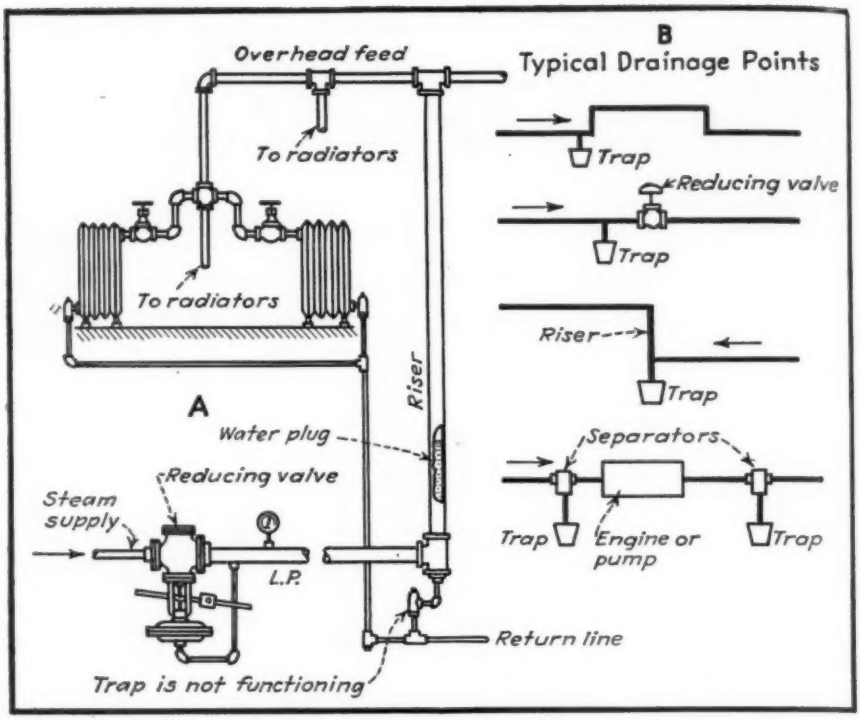


Fig. 2—(A) Condensate that accumulates in risers fed by pressure-reducing valves builds up false pressure on diaphragm. Avoid this by keeping traps in good repair

Differential Pressure

All buoyancy traps operate on differential pressures, and it is not important whether the discharge is to vacuum or against a backpressure. When a trap discharges into a vacuum system, differential pressure is *increased* about a half pound for each inch of vacuum. For example: A trap with 100 psi at the inlet and discharging to a 20-in. vacuum has a differential pressure of 110 psi.

Each foot of *lift* (head) on the trap discharge *adds* about a half pound to the backpressure. For example: A trap with 100-psi inlet pressure discharging to atmosphere, but with a 10-ft lift or head on the discharge side, has a backpressure at the trap of about 5 psi and the differential pressure is 95 psi.

Each foot of static head on trap inlet *adds* a half pound to the inlet pressure, which means that if the head on the

USING REFLASH STEAM SAVES MONEY

H-p condensate lb per hr	*Reflash steam (11.2%), lb*	*Saving, dollars*		
		Per hr	*Per day*	*Per year*
1000	112	.04	1.08	388.80
2000	224	.09	2.16	777.60
4000	448	.18	4.32	1555.20
5000	560	.22	5.40	1944.00
10,000	1120	.45	10.80	3888.00

Savings are based on steam cost of 40 cents per 1000 lb.

inlet is 20 ft and the operating pressure 100 psi, total pressure on the inlet is 110 psi. When traps discharge to atmosphere, difference between differential pressure and inlet or operating pressure is usually so slight that only operating pressure is considered. When ordering a trap, give the manufacturer: (1) inlet pressure (2) outlet pressure—unless discharging to atmosphere (3) amount of condensate to remove.

Most difficult problem is determining the amount of condensate to remove. Usually it can only be estimated. Fortunately most trap manufacturers provide simple rules for determining condensation rates; equipment manufacturers have reliable figures on condensing rates for their machines. Sizing data is too extensive to cover here but the following are a few considerations frequently overlooked in checking condensation rate. (1) Are pressures constant? If not, trap capacity will change as inlet or outlet pressures vary. (2) Is condensation rate steady? A trap may be large enough for normal operation but far too small for warm-up loads. Condensing rate for 5 min may be many times that allowed when computed on an hourly basis. Traps are rated in pounds per hour, so consider peak load when purchasing a trap. (3) Has consideration been given to entrained air? A trap may be large enough to handle the water but too small or of wrong design to remove air.

Intermittent Discharge

Certain traps, including the open and inverted-bucket units, discharge intermittently. This is desirable for purging lines of air and improving circulation. However, there are certain installations—time-temperature processes particularly—that require continuous condensate flow through the trap to avoid instrument lag. Here a continuous-flow trap serves best.

To provide correct intermittent discharge and yet operate with minimum maintenance a trap should have a capacity at least three times normal condensate flow. At peak loads, intermittent-discharge traps may operate continuously (and they will if condensate flow is equal to or greater than trap capacity). Therefore peak load must be considered so that traps are large enough to handle continuous operation and at the same time be able to operate intermittently when condensate flow returns to normal.

For best results install traps at low points (risers), end of mains, at intervals on long runs of pipe, ahead of equipment requiring dry steam such as reducing valves and process units, and as a drain on each piece of steam equipment, Fig. 2, A and B. Install them singly, that is, one trap to a unit, Fig. 3A, because no two pieces of equipment condense steam at exactly the same rate. Where one trap drains several units, air and condensate are likely to accumulate in one machine. This short-circuiting results in lower efficiency, longer heating time, uneven rate of heat and increased rate of radiation loss. This means increased steam consumption and higher labor cost for production slowup.

Never discharge condensate from high-pressure traps directly to the sewer even though the condensate is not to return to the boiler. Such practice wastes fuel. When discharging to a lower pressure, a certain percentage of the condensate flashes into steam. Flash steam from medium and high pressures can be recovered by passing the discharged condensate through a heat exchanger, water heater, feedwater preheater or into a low-pressure heating main. Amount of reflash is easily computed. For example: When discharging 125-psi condensate into a 15-psi system, 11.2% of the condensate flashes into steam.

125 psi (353 F) = 324 Btu (heat in liquid)
15 psi (250 F) = 218 Btu (heat in liquid)

Difference 106 Btu

Latent heat at 15 psi = 945 Btu per lb

$$\frac{106}{945} = .112 \text{ or } 11.2\%$$

This means that if steam costs 40 cents per 1000 lb, using the reflash from 5000 lb of condensate an hour saves more than $1944.00 a year (see table on facing page).

Installation Pointers

Follow these pointers when installing traps:

(1) Connect them close to and preferably below the unit they drain so that condensate reaches the trap by gravity, Fig. 3A.

(2) Make them accessible for easy maintenance.

(3) Install in an upright position.

(4) Connect inlet and outlet correctly.

(5) Use shutoff valves and unions on both inlet and outlet to make removal for maintenance easy, Fig. 3B.

(*Continued on page* 146)

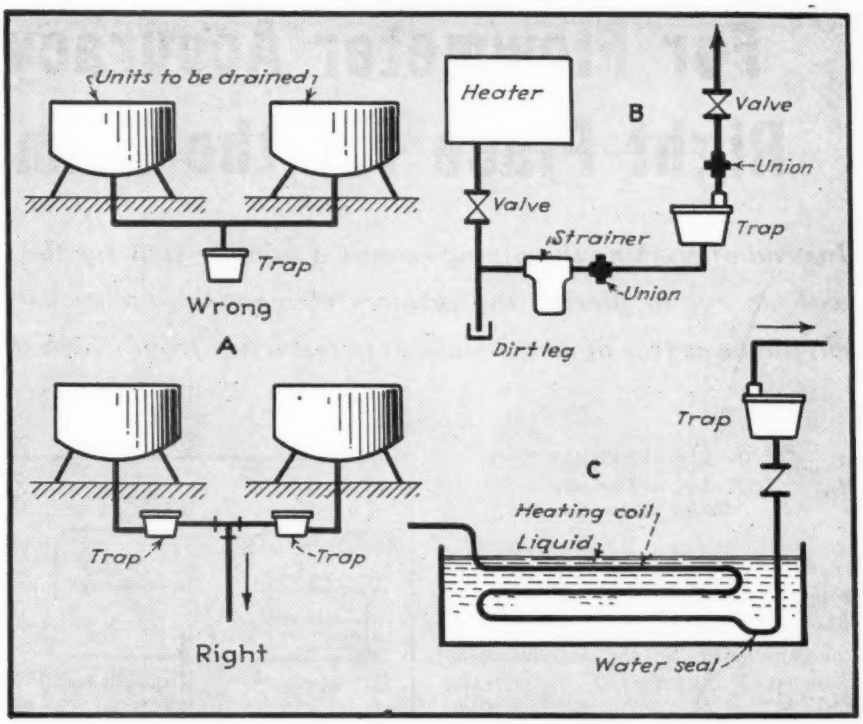


Fig. 3—(A) Units work best when each has a trap. (B) Unions and valves facilitate repairs. (C) When trap is above the unit, a check valve prevents loss of prime

Correction

On page 88 of May POWER a chart for air velocities was miscalculated in our editorial offices. The vertical scale representing areas of openings should be divided by 60 to make the graph correct. Our apologies to the author as well as to our readers.

For Flowmeter Accuracy Select the Right Place for the Primary Element

Instead of erecting the piping around a suitable spot for the orifice, lay out the main piping with an eye to placing the primary element advantageously. First requirement: Fluid flow should be as free of disturbance as in test setup from which the meter constants were derived

By R E SPRENKLE
Hydraulic Engineer
Bailey Meter Co

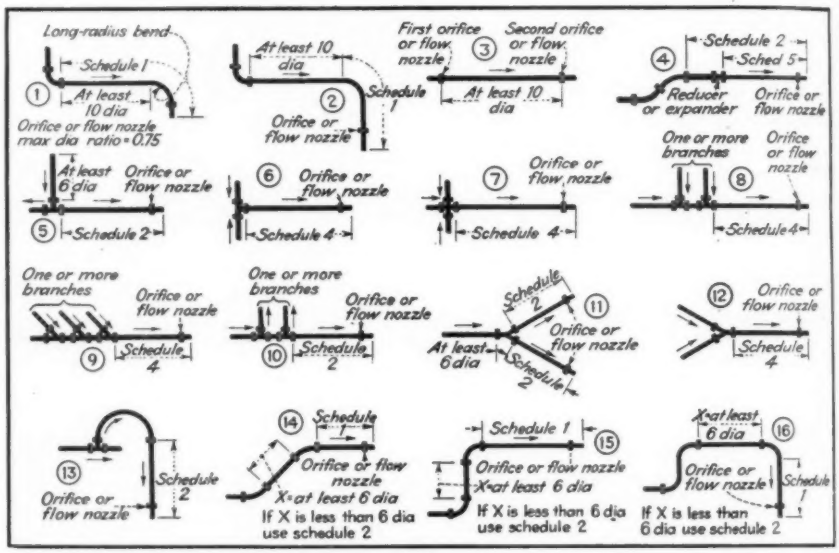


Fig. 2—Multiple-entrance flows produce disturbances of such magnitude that they are particularly difficult to eliminate. Follow the pipe schedule specifications closely

► PIPING-ARRANGEMENT STUDIES of fluid flow, made with air, gas and water in the laboratories of the American Gas Association, University of Pennsylvania, Case School of Applied Science, Ohio State University and many industrial concerns, have produced data to formulate *Piping Requirement Standards* —basic rules upon which to make piping recommendations—Fig. 1 on facing page. They are divided into eight schedules; seven designate the length of straight pipe needed for orifices or flow nozzles, while the eighth covers venturi tubes. In addition, these standards specify that no thermometer well, bulb or socket, resistance element or other similar unit be located closer than six pipe diameters to the primary element on the outlet side, nor closer than 15 diameters on the inlet side.

The required length of straight pipe preceding and following the orifice or nozzle increases both with diameter ratio and complexity of the piping arrangement. Diameter ratio is d ÷ D, in which *d* is the diameter of the primary-element throat, and *D* is the internal pipe diameter.

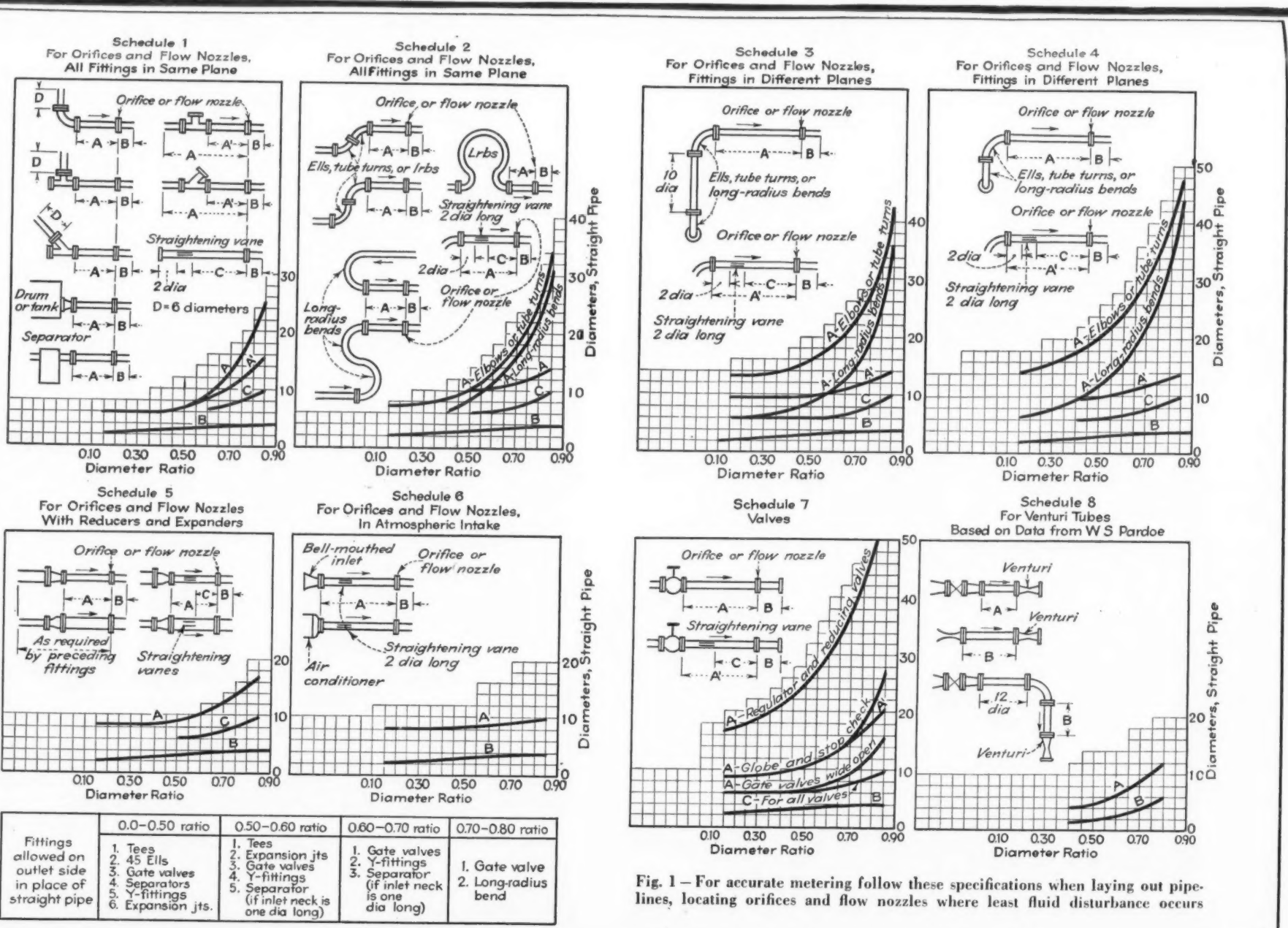
To better understand the standard schedules, Fig. 2, 3 and 4 convert them into terms of typical piping arrangements commonly met in industrial applications, and apply the particular schedule to each. Consider bends or fittings in the same plane: diagram 1, Fig. 2, shows that the orifice or flow nozzle can immediately follow a long-radius bend if the following conditions are met: (1) There must be at least ten diameters of straight pipe preceding the long-radius bend (2) diameter ratio of the orifice or flow nozzle must not exceed 75% (3) radius of the bend must be five pipe diameters or more.

Diagram 2 differs from 1 in that there must be a length of straight pipe between the bend and orifice, or nozzle, if the diameter ratio of primary element exceeds 75%. If a 10-diameter length of straight pipe precedes the bend it can again be considered as the equivalent of so much straight pipe, as in diagram 1, so the length of straight pipe *following* the bend plus the developed length of the bend can be assumed to meet the requirements of schedule 1, Fig. 1. (Refer to Fig. 1 for all schedule references.)

Occasionally two orifices or flow nozzles are installed in series to operate check meters, diagram 3, Fig. 2. A particular application is made when a producer sells quantities of steam, gas or liquids to a consumer, each party to the contract having an independent meter to check billing charges. Here there must be at least ten diameters of straight pipe between the two primary elements to allow complete pressure restoration from the first orifice or flow nozzle before the second is reached.

Diagram 4 illustrates a point not readily apparent from schedule 5 but important, nevertheless. If other fittings or bends precede an expander or reducer the length of straight pipe between such fittings and the primary element must meet the requirements of the schedule that represents the bend combination. In diagram 4, for example, when two bends in the same plane precede the reducer, total length of straight pipe between the last *bend* and the orifice or flow nozzle must agree with schedule 2. However, only the lengths specified by schedule 5 are required between the *reducer*, or expander, and the orifice, or nozzle. Obviously if long lengths of straight pipe precede the reducer or expander, only the requirements of schedule 5 apply.

Flow entering one end or side of a tee, diagram 5, or a Y-fitting, diagram 11, and splitting into two separate exit flows, creates a disturbance in that fitting, which requires that somewhat longer lengths of straight pipe be used to smooth out the flow, schedule 2. Use the elbow curve, schedule 2, because the turn through a tee is similar to that through an elbow. When the inlet flow enters from both ends of the tee, dia-



Fittings allowed on outlet side in place of straight pipe	0.0–0.50 ratio	0.50–0.60 ratio	0.60–0.70 ratio	0.70–0.80 ratio
	1. Tees 2. 45 Ells 3. Gate valves 4. Separators 5. Y-fittings 6. Expansion jts.	1. Tees 2. Expansion jts 3. Gate valves 4. Y-fittings 5. Separator (if inlet neck is one dia long)	1. Gate valves 2. Y-fittings 3. Separator (if inlet neck is one dia long)	1. Gate valve 2. Long-radius bend

Fig. 1 – For accurate metering follow these specifications when laying out pipelines, locating orifices and flow nozzles where least fluid disturbance occurs

gram 6, or from one end and the side, diagram 8, with discharge emerging from the other end, use schedule 4 requirements for elbows. The reason is that two or more entrance flows mixing in a single fitting produce a turbulence equal in magnitude to that created by two turns at right angles to each other.

Diagrams 7 and 9 show other multiple-entrance flows. Remember that when several entrance lines successively discharge into a common header, diagrams 8 and 9, magnitude of disturbance produced may increase with the number of such inlet flows, so that it is sometimes necessary to use a straightening vane in addition to the lengths of straight pipe as required by schedule 4 for elbows.

Multiple Entrances

Diagram 12 shows a typical arrangement for joining two lines into one; for example: two steam leads from a double-outlet boiler that merge into one pipe before connecting to the header. To eliminate the disturbance created by a Y-fitting, this arrangement requires the maximum lengths for elbows called for in schedule 4.

Diagrams 13 to 16 give simple applications of the requirements of schedules 1 and 2 to piping systems having two or more bends all in the same plane. If six diameters or more separate these bends, schedule 1 applies; but if there are less than six diameters of straight pipe, schedule 2 applies.

Isometric diagrams 17 to 22, Fig. 3, show a series of typical takeoff connections from a header to a turbine, blower, pump or compressor, or to a distribution line. In every instance the header tee must be considered as having the same effect as an elbow and thus as a 90-deg bend in the fluid-flow path.

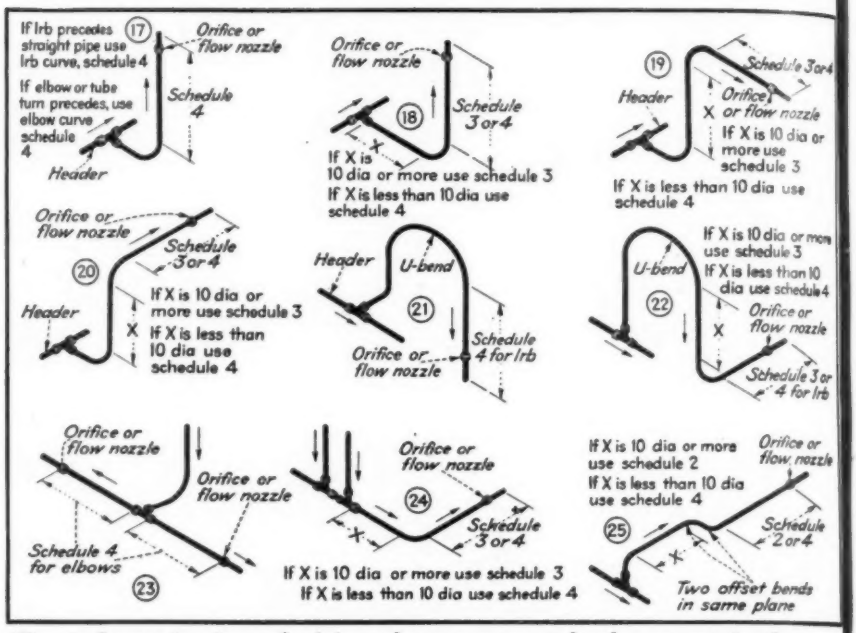

If lrb precedes straight pipe use lrb curve, schedule 4
If elbow or tube turn precedes, use elbow curve schedule 4
Orifice or flow nozzle
Schedule 4
Header
If X is 10 dia or more use schedule 3
If X is less than 10 dia use schedule 4
Schedule 3 or 4
U-bend
Schedule 4 for lrb
Schedule 4 for elbows
If X is 10 dia or more use schedule 2
Schedule 2 or 4
Two offset bends in same plane

Fig. 3—Isometric views of piping where component bends are not in the same plane. Schedule used depends on amount of straight pipe between preceding bends

The simplest arrangement of this group is shown in diagram 17 where a long-radius bend closely follows the tee at the header discharge. Since the plane of the bend is at right angles to the plane of flow through the tee, there are, in effect, two bends at right angles to each other, which require schedule-4 piping lengths for long-radius bends. If an elbow or tube turn is used instead of a long-radius bend, follow schedule 4 requirements for elbows. If a piece of straight pipe shorter than 10 diameters follows the header tee, diagram 18, apply schedule 3 requirements for long-r dius bends instead.

In diagram 19, schedule 3 or 4 requirements apply in spite of the fact that the two bends preceding the orifice or flow nozzle are in the same plane. The reason is that the flow turns through the header tee, preceding these bends, at *right angles* to the plane of the two bends and, therefore, the stricter requirements apply. The same procedure applies to diagram 21 in which another bend ahead of the U-bend is at right angles to it, and thus dictates the requirements of schedule 4 for long-radius bends.

Diagrams 23 and 24 show flow entering a header from one or more inlets. In both consider the header tee as a bend, so that together with the bend either preceding it, as in 23, or following it, as in 24, a 2-bends-at-right-angles combination results, and schedule 4 must be applied. Schedule 4 curve for elbows applies to diagram 23, whereas schedule 4 for bends applies to 24.

Consider offsets in the same category as full bends if the amount of offset is two or three pipe diameters. Diagram 25 illustrates an application where two bends at right angles precede the offset.

Isometric diagrams in Fig. 4 show typical outlets coming directly from a boiler drum and superheater header. Several important points are worthy of mention in connection with these piping arrangements.

The first is that an angle stop-check valve must always be considered as an elbow and included as an *integral part of the piping arrangement that immediately follows it.* You cannot start at

(*Continued on page* 142)

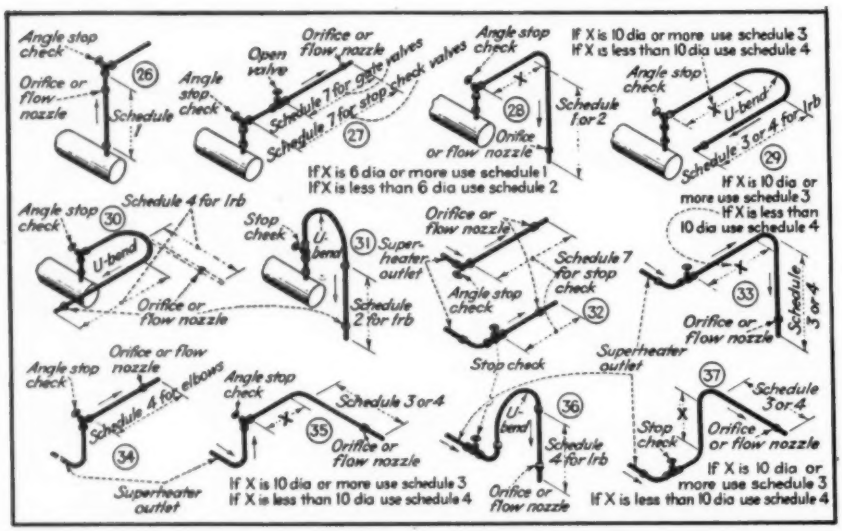

Angle stop check
Orifice or flow nozzle
Schedule 1
Open valve
Schedule 7 for gate valves
Schedule 7 for stop check valves
Schedule 1 for 2
If X is 6 dia or more use schedule 1
If X is less than 6 dia use schedule 2
If X is 10 dia or more use schedule 3
If X is less than 10 dia use schedule 4
Schedule 3 or 4 for lrb
Schedule 4 for lrb
U-bend
Stop check
Superheater outlet
Schedule 2 for lrb
Schedule 7 for stop check
Schedule 3 or 4
Schedule 4 for elbows
Schedule 3 or 4
Schedule 4 for lrb

Fig. 4—When bends or turns closely follow an angle stop-check valve, the latter is considered to have the same disturbing effect on fluid-flow as an elbow in the pipeline

Multi-Stage Ejectors For High-Vacuum Performance

Last month Phil Freneau detailed operating checks for single-stage ejectors. Here he reviews the more complex characteristics of multi-stage units of several jets in series, with their associated intercoolers and aftercoolers

▶ TWO-STAGE EJECTORS can maintain condenser pressures as low as 0.5-in. Hg. Normally, an intercondenser between stages removes most of the first-stage motive steam and the vapor component of the mixture drawn from the condenser. An aftercondenser follows the second stage to recover heat and condense steam from the second jet although some prefer to discharge the air-vapor mixture to a deaerating heater.

Inter- and aftercondensers are frequently combined in one shell for simplicity and compactness. Stages are usually numbered from the suction connection to the discharge, the first stage being the one connected to the condenser and the second discharging to heater or atmosphere through the aftercondenser.

Second-stage jet characteristic curves are similar to those of single-stage ejectors (POWER, June, 1945, pp. 76-78) the only difference being that second stages are generally designed for higher absolute suction pressure (poorer vacuum). Load to the second-stage suction consists of noncondensables from the condenser, plus moisture corresponding to saturation pressure of the intercondenser.

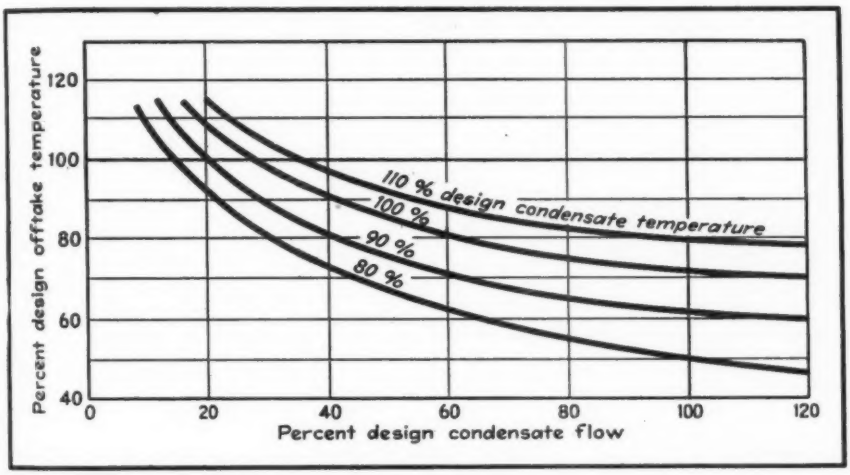


Fig. 1—Plot of typical intercondenser performance showing effect of increased condensate flow on "offtake" temperature of vapor to second stage in percent

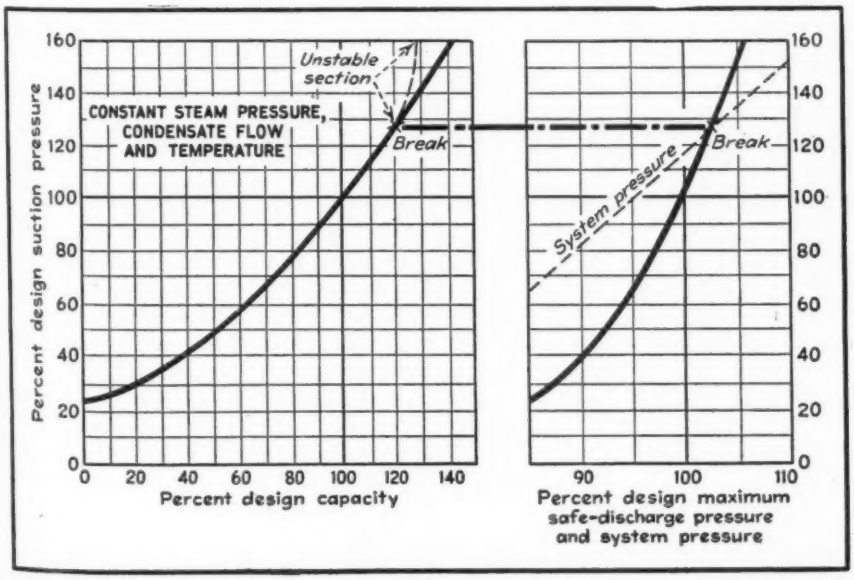


Fig. 2—Typical performance curve for first stage of 2-stage ejector. First stage normally operates against relatively wide variations in system backpressure

Intercondenser Function

The intercondenser behaves toward the second-stage jet much like the main condenser in a single-stage installation. The amount of vapor to the second-stage suction can be determined (by Dalton's law, in POWER, May, 1945, page 134) just as for the single-stage ejector. However, the second-stage must be designed to maintain desired pressure in the intercondenser when handling maximum design weight of noncondensables and associated vapor. Second-stage jet and intercondenser determine system pressure of the first-stage discharge.

An ejector intercondenser differs in both duty and design from a conventional condenser. Several factors must be considered: (1) desired absolute pressure (2) quantity of vapor (3) percent air in vapor (4) allowable amount of vapor to second-stage suction (5) minimum and maximum quantity of cooling water (6) maximum temperature of water (7) allowable pressure drop of water (8) space limitations (9) desired length of vapor path (10) size and material of tubes (11) condensate drain temperature (12) number and arrangement of ejector assemblies and (13) working pressure of parts. These factors cannot be combined perfectly since some have opposite design effects so that compromises have to be made to give the best over-all unit.

Cooling water is usually condensate

taken from the main condenser hotwell. Three common expedients are employed to make up for insufficient flow during starting: (1) separate noncondensing priming ejector (2) recirculation of condensate and (3) separate raw-water passes in the ejector condenser. Of these, the separate priming ejector or "hogger" usually proves the best choice.

While priming ejectors have high steam-consumption rates, their use for brief periods at long intervals costs relatively little. They are designed for high capacities to effect rapid evacuation of the condenser space even while air enters through low-pressure glands before the seals become effective.

Condensate recirculation is quite satisfactory provided gland leakage is not too great to prevent second stages priming the system. An automatic or manual control passes condensate back over main-condenser tubes to be cooled. As more condensate becomes available, part and then all of the flow goes to the feed heaters.

Raw-water passes also enable second-stage jets to prime the system and bring first-stage jets into operation before there is enough condensate to care for the ejector steam. However, a small amount of raw water should be circulated at all times to prevent damage from the raw-water tubes running dry.

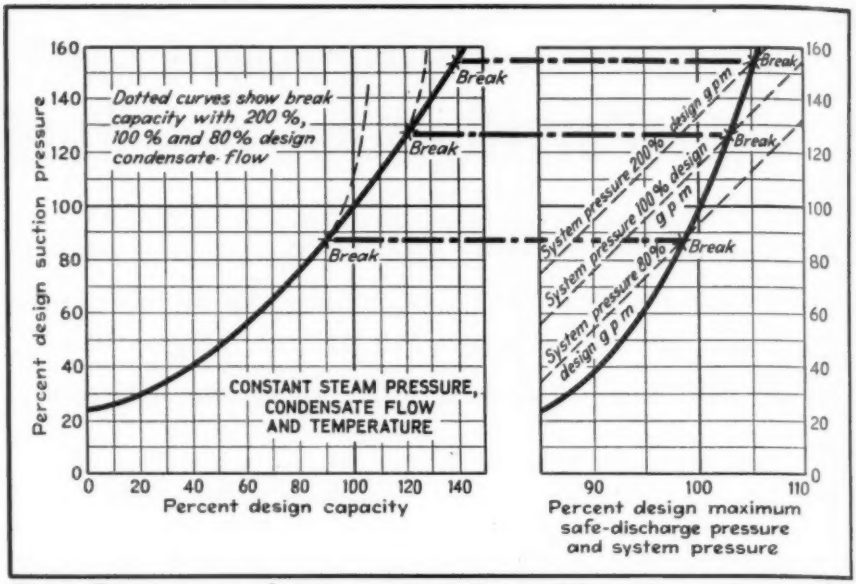

Percent design suction pressure
Dotted curves show break capacity with 200 %, 100 % and 80 % design condensate flow
Break
Break
Break
CONSTANT STEAM PRESSURE, CONDENSATE FLOW AND TEMPERATURE
Percent design capacity
System pressure 200% design g p m
System pressure 100% design g p m
System pressure 80% design g p m
Break
Break
Break
Percent design maximum safe-discharge pressure and system pressure

Fig. 3—For constant condensate temperature but variable condensate flow through intercondenser, first-stage jets operate against varying backpressure (at right)

This flow represents a constant heat loss from the plant.

The intercondenser should, of course, be as compact as possible. However, physical difficulties of mounting ejector elements as well as drain and gage connections set a practial minimum in this direction. Necessity of adequate length of path for vapor and sufficient tube cross-section to pass maximum condensate flow also forces compromises in intercondenser dimensions.

To meet the varying factors, manufacturers have adopted standard designs, which differ widely from each other depending on which of the factors is given greatest weight. In almost every case, however, these compromises result in considerably more surface than is actually required to condense steam and vapor. All the user need know about the intercondenser to determine limitations on ejector performance is (1) vapor pressure drop across the intercondenser and (2) amount of vapor entering second-stage suction.

Fig. 1 shows a plot of typical intercondenser performance in percent of design conditions. For a given condensate inlet temperature, vapor temperature to second-stage suction decreases as condensate flow increases. Temperature contours fan out as flow increases depending on design. Counter-current flow of vapor and condensate results in least fanning and flattest curve.

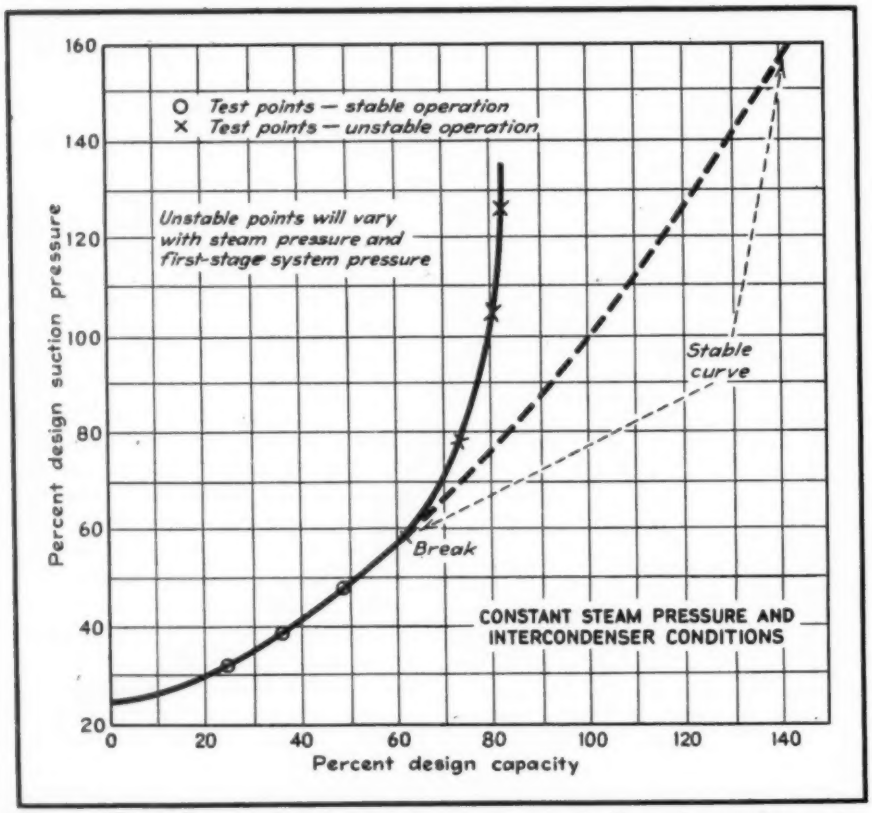

O Test points — stable operation
× Test points — unstable operation
Unstable points will vary with steam pressure and first-stage system pressure
Stable curve
Break
CONSTANT STEAM PRESSURE AND INTERCONDENSER CONDITIONS
Percent design suction pressure
Percent design capacity

Fig. 4—"Dry-air" test of 2-stage ejector causes overloading of second-stage jet at low loads on first stage. Test is limited and not recommended as standard

Counterflow Design

Actually, curves of Fig. 1 vary also with suction pressure and load to the intercondenser, but counter-current design is least affected and one set of curves is often adequately representative. Parallel or crossflow designs probably require several curve plots similar to Fig. 1.

Fig. 2 illustrates performance of a typical first-stage of a 2-stage ejector. The principal difference between this and a single-stage unit lies in the system backpressure against which they compress. The second stage operates against a substantially constant pressure while

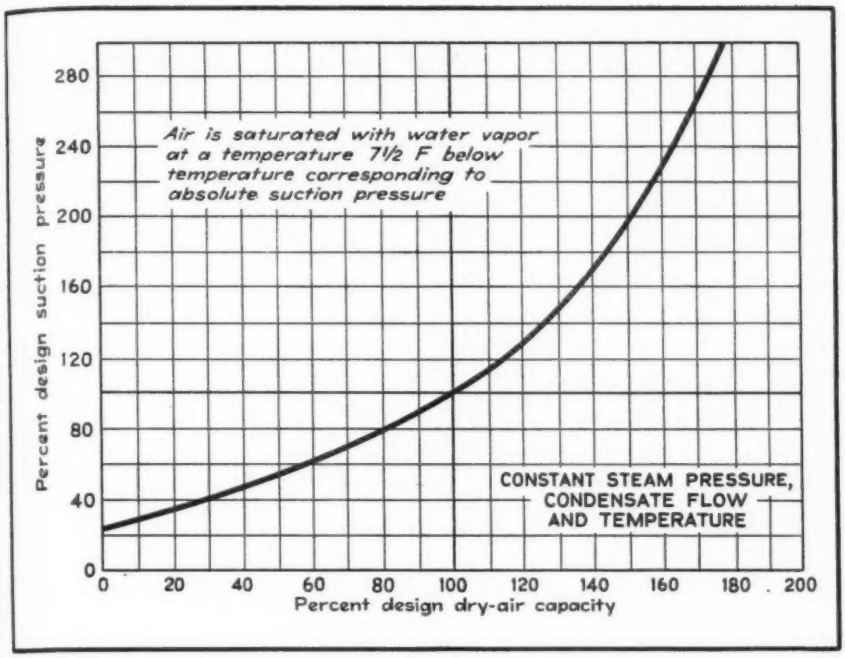


Fig. 6—Dry-air capacity plotted against design suction pressure for air saturated with water vapor at a temperature 7½ F below saturation at suction pressure

the first stage works against variable system pressure.

Pressure in the intercondenser is a direct function of load on the second-stage suction. To determine magnitude of this load it is necessary to know only the amount of noncondensables and the amount of vapor they will pick up in the intercondenser. Noncondensables are measured by an air meter. Moisture of saturation can be calculated (POWER, May, 1945, p 134) employing a curve similar to Fig. 1. For each condensate flow and inlet temperature it is a simple matter to draw a system pressure curve which is a function of the noncondensables.

Several system pressure curves are shown in Fig. 3 for varying flows of condensate but constant inlet temperature. As long as system pressure lies to the left of maximum safe discharge pressure the first stage will operate stably. At points where system-pressure curves cross the discharge-pressure curve, breaks occur and the first stage becomes unstable as shown by dotted curves.

The second stage can operate stably even though the first stage is in the break. First-stage break operation is usually not marked by bobble or fluctuation. At very low loads the second stage may operate in the break without affecting the first stage as long as magnitude of the bobble does not cause first-stage system pressure to exceed its safe discharge value.

With individual stage curves and intercondenser performance, the operator can analyze condenser behavior as well as determine air leakage. Other methods of presenting ejector data in general use do not afford as convenient a check.

Most commonly requested test of a 2-stage ejector is the so-called "dry-air" test. For this, the complete unit is set up and atmospheric air to the first stage is measured by suitable orifices. Resulting data plots as shown in Fig. 4. Since second stages are normally designed for smaller capacity than first stages, comparatively small weights of air are sufficient to overload the second stage and cause the maximum safe discharge pressure of the first stage to be exceeded. For this reason the sharp break of Fig. 4 occurs at much lower load than design. The dotted curve indicates stable first-stage performance.

Test Limited

Note that orifice measurements taken in the break are unreliable as they vary with steam pressure. The dry-air check is quite limited and cannot be recommended as a standard test. Just as satisfactory results can be obtained by checking the unit at shutoff, for this proves stability as well as low-load readings from dry-air tests. On the other hand, dry-air test is an excellent check of intercondenser performance and is so used by some ejector manufacturers. The air component is more accurately known than is possible with other tests using air meters.

Saturated-air tests are more informative than dry-air tests and are frequently requested. For this, air is bled through calibrated orifices and through a water bath maintained at desired temperatures. In this way the air is saturated with water vapor under controlled conditions. Fig. 5 shows a plot of typical data obtained. Sharp breaks are due to the overloaded second stages causing

(*Continued on page* 136)

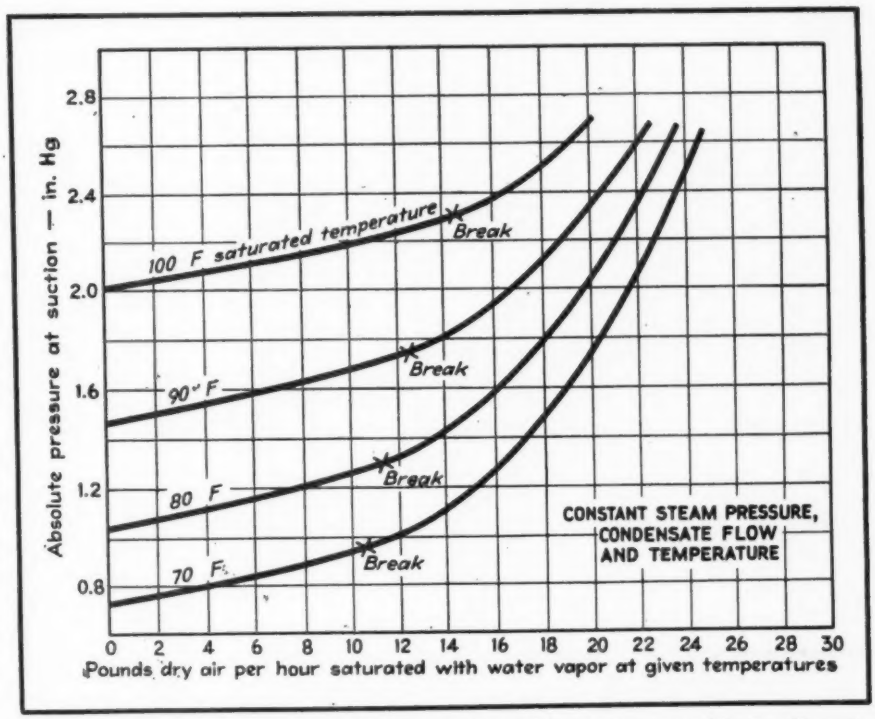


Fig. 5—Plot of typical "saturated-air" test in which ejector assembly handles air passed through water bath under controlled temperature and pressure conditions

Stacks Rebuilt Without Halting Service

Fig. 1—Original stack shows channels welded to base to support new shell

Corrosion of riveted joints forced replacement of 14 old stacks. Without interrupting service, new welded stacks were erected around the old. Then they were knocked down inside and the debris removed through cleaning openings

► BY AN UNUSUAL APPLICATION of arc welding, 14 badly depreciated old steel stacks in the Cleveland plant of the Republic Steel Corp have been replaced without interrupting service, the new shells being welded in place to encircle the old.

In a study of this project the Lincoln Electric Company, producers of arc-welding equipment, reports that the stacks were replaced at half the original cost estimate.

The old stacks of riveted construction towered 155 ft over the open-hearth furnaces of the Republic Steel Corp, and were 6 ft, 8 in. in diameter. They were corroded and warped, particularly at the seams where some of the rivet heads had disappeared completely.

The old riveted type of construction is indicated in Fig. 1. In Fig. 5 the shaded areas show how moisture and corrosive gas worked in between the plate and behind the rivet heads.

Facing this maintenance problem, engineers of the McDowell Co, stack repair and replacement specialists of Cleveland, decided that the work could be handled at the job site without shutting down the individual furnaces during the process.

They first flame-cut specimens of the old stacks from various sections of the structure to confirm the extent of dam-

Fig. 2—Eight 5-in. channels were fillet welded to the old riveted base to carry the weight of the new all-welded stack

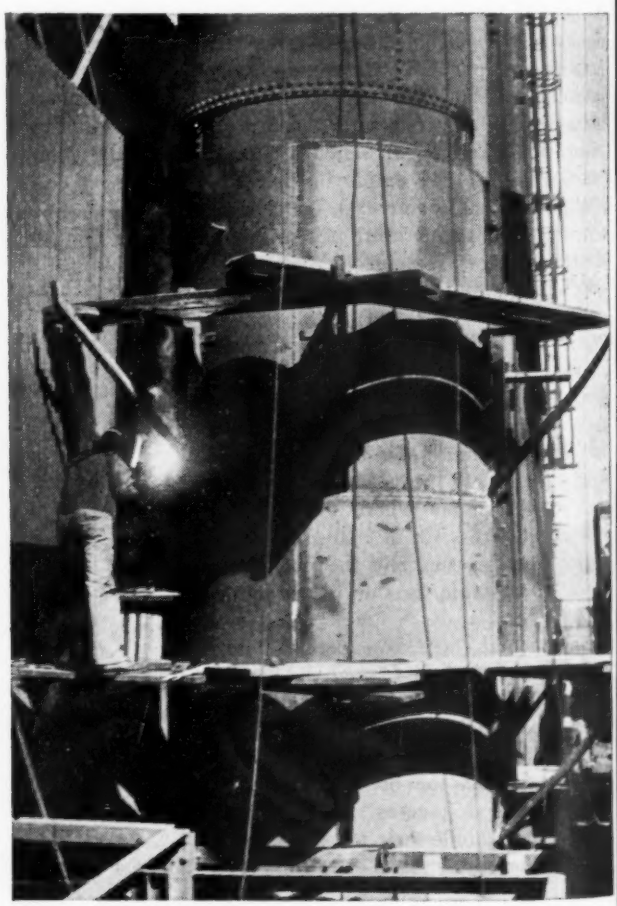


Fig. 3—After this new shell was completed, old shell was knocked down inside and debris removed through base opening

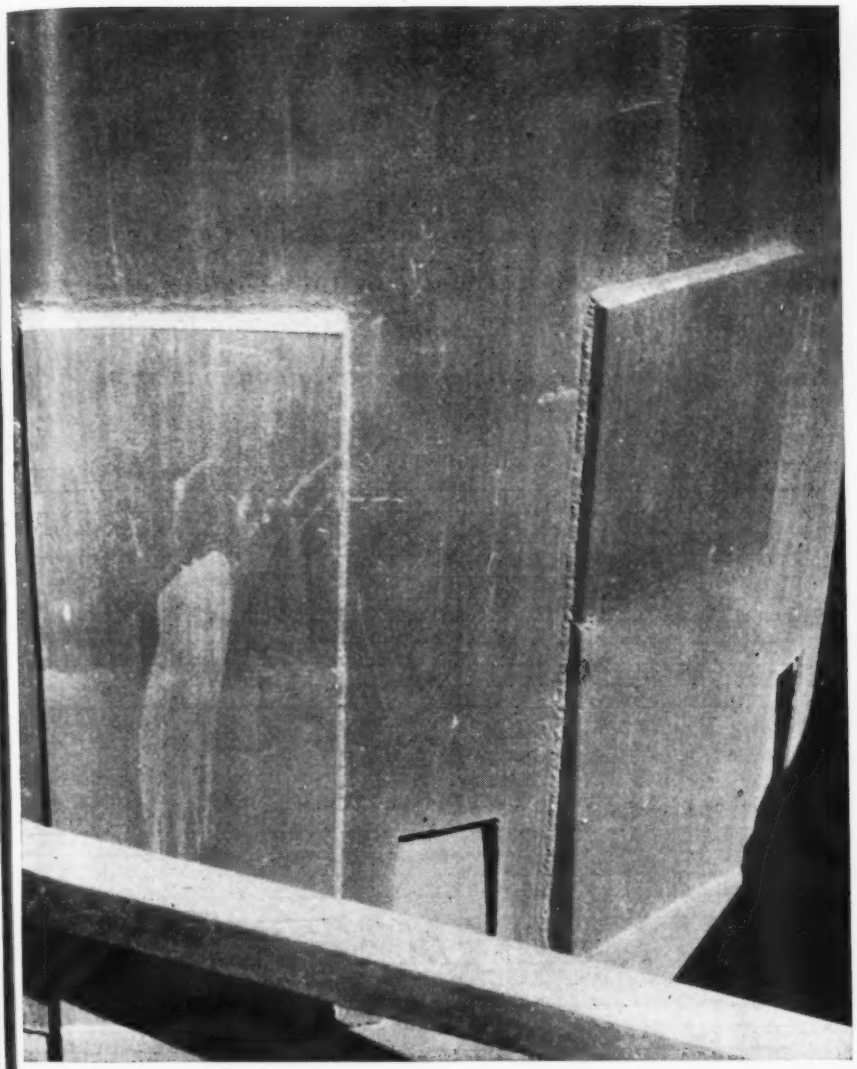


Fig. 4—Straight and tapered plate sections, welded to lower part of new shell, carry its weight down to channels fillet welded to the original riveted stack base

age caused by corrosion. Next they reinforced the base of the stacks with eight 5-in. channels positioned longitudinally against the base, Fig. 2, and solidly fillet welded all around to the old material.

Details of the welded construction at the juncture of the base and the stack proper are shown in Fig. 4. Here, a tapered plate section is welded directly to the top of the reinforcing channel member with a second plate section adding to the length. Both plate sections are fillet welded to the lower portion of the new stack.

A distinguishing feature of this project is that the new stack, of diameter 8 in. larger than the old, is erected around the old structure, thus permitting furnace operation during stack reconstruction. The larger-sized stack will also accommodate increased furnace capacity and conform to modern theories of open-hearth furnace practice.

Fig. 3 shows part of the new welded stack under erection around the old riveted stack. Each section of the new structure is made up of two pieces of half-round formed plate, butted together and welded with $\frac{5}{32}$-in. general-purpose shielded-arc electrode for mild steel (American Welding Society Specifications E-6010).

Longitudinal seams are double-bevel butt-groove joints with a $\frac{1}{8}$ by 2 in. back-up strip, tack welded on the inside (Fig 6). Circumferential seams are single-bevel butt-groove joints (Fig 7) also utilizing the back-up strip.

Material thickness for the lower half of the stack is $\frac{3}{8}$ in. with four passes to complete the welded joint. The upper half is of $\frac{5}{16}$-in. plate with three passes of the electrode.

Fig. 8 shows one of the all-welded new stacks. After completion, the riveted stack was knocked down inside the new structure and the old corroded material removed through the furnace clean-out aperture at the base.

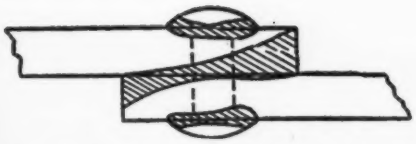


Fig. 5—Shaded areas show typical corrosion of rivets and the adjacent plate

Fig. 6—The longitudinal seams are double butt-groove joints with back-up plate tack welded on the inside of stack

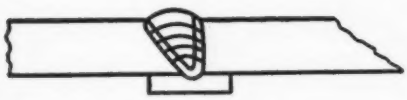


Fig. 7—The circumferential seams are single butt-groove welds with back-up plate welded on the inside of stack

Fig. 8—Diameter of the 155-ft finished stack is 7 ft, 4 in. Note vents between the welded channels to admit the air draft between the old and the new shells

How Does Supercharging Affect Diesel-Engine Design and Operation?

From experience with turbocharged units, R L Boyer, Cooper-Bessemer Corp, concludes that although effects seem relatively slight, best results require that the engine be designed specifically for supercharging. At same meeting, L M Tichvinsky, American Bearing Corp, outlines causes of bearing failures and progressive inspection and maintenance methods

▶ DATA OF CONSIDERABLE VALUE to engineers interested in diesel operation and design were presented at a wartime-emergency local meeting of the oil and gas power division, ASME, held at the Hotel Statler, Cleveland, on May 10. The program featured papers on supercharging, bearings, exhaust systems and combustion research, which had been scheduled for the national meeting originally planned for Milwaukee and postponed because of the Government ban.

From considerable experience with turbocharged engines of medium size and speed, R L Boyer, chief engineer, Cooper-Bessemer Corp, outlined the factors involved in designing an engine for supercharged operation, pointing out that for best results more is involved than merely adding a turbocharger. For example, although many engines having single inlet and exhaust valves have been supercharged successfully, the 4-valve engine with two inlet and two exhaust valves is much more thoroughly scavenged and thus more adaptable to effective supercharging. The extra cost of this construction proves worth while in view of the higher ratings obtainable and the advantages of a symmetrical piston head.

Valve Overlap

Effective scavenging, Mr Boyer stated, is believed to be responsible for as much increase in output as the supercharging itself—thus the need for materially increased overlap in timing of inlet and exhaust valves. The exhaust valve stays open longer and the inlet opens earlier, insuring that a considerable amount of air goes directly from inlet to exhaust, thoroughly removing residual gas. Fig. 1 shows comparative timing diagrams for atmospheric and supercharged engines. Such timing changes require, of course, different cams.

Piston changes for supercharging usually include pockets for valve clearance and provisions for additional cooling. With shallow combustion chambers in direct-injection engines, pistons must usually be notched at the top to clear the valves. In the supercharged engine, the valves stay open much longer and the pockets must be quite deep. This usually means not only machining the pockets but also a change in core contour to permit this machining. The higher rate of heat dissipation in supercharged engines requires special attention to cooling upper end of liner and piston. It is absolutely essential that cooling water be brought up near, or even above, top ring travel. For moderate or high speeds, especially with larger engines, it is necessary to provide adequate piston cooling, oil being the means most often accepted. Heat must be removed from the ring section particularly, and a heat dam between crown and ring section proves effective.

Engines must have sufficient compression to start cold and, during starting, supercharging has little if any effect. Thus when supercharging pressure is added to inlet air, peak pressure increases. A study of a large number of engines indicates that cylinder pressure usually increases 10 to 15%, which naturally means increased stresses in all parts. Stress increase can readily be allowed for in designing a supercharged engine, and in conversion from atmospheric to supercharged operation such an increase is not likely to be of serious consequence if the original design was reasonably conservative.

Higher cylinder pressures, somewhat greater shock load and more sustained load all add up to increased duty on bearings of supercharged engines. With engines of moderate or high speed, detailed analysis of the area of the bearing pressure-time diagrams shows that frequently this area is actually somewhat less with supercharged engines

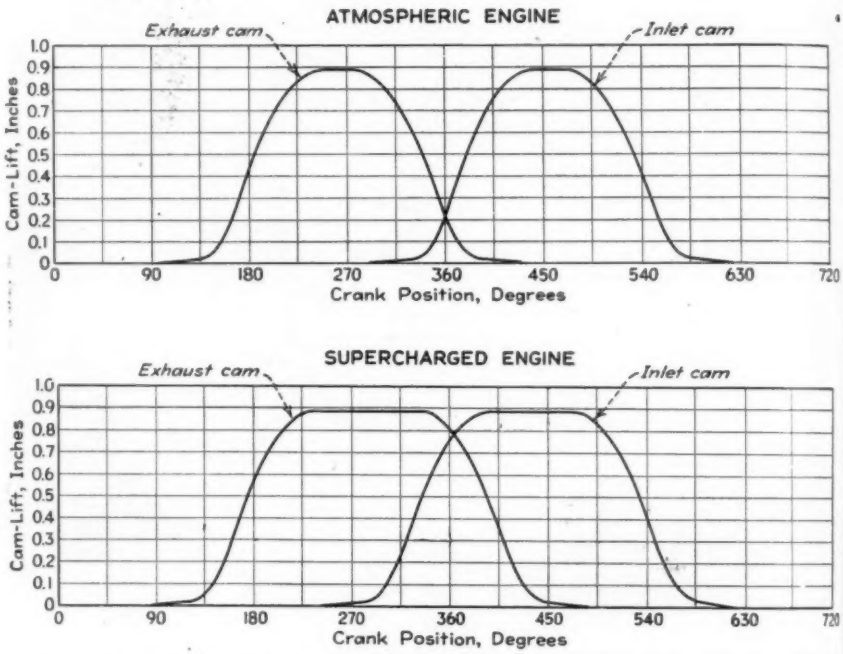


Fig. 1—Cam-lift diagrams show differences in valve timing between atmospheric and supercharged engines, with increased overlap characteristic of the latter

This results from a combination of more load and inertia forces. At zero speed the pressure-time diagram has a greater area, about in proportion to the polar diagrams of Fig. 2. In general, it may be said that most modern diesel engines, particularly if equipped with properly designed precision bearings, require no bearing changes for supercharging. However, the increased bearing duty makes it wise to provide increased oil flow to insure proper cooling.

Since the indicator card of a supercharged engine is fatter, with more sustained pressure and temperature, increased heat rejection to water and oil is logical. However, it does not increase nearly as much as power increases and thus *rate* of heat rejection is materially reduced. A study of eleven engines, five atmospheric and six supercharged, shows an average increase in bmep or hp of 42.5%. Over-all heat rejection, including lube-oil cooler and water jackets, ran 2482 Btu per hphr for atmospheric engines and 1841 for supercharged units. This indicates that a horsepower increase of 42.5% involves an increase in heat dissipation of only 5.85% and thus heat dissipation equipment need not be materially increased for normal supercharging. In fact, assuming the cooling system was reasonably conservative in design, it should be adequate when changing over to supercharging. Rate of flow on water pumps need not be increased materially.

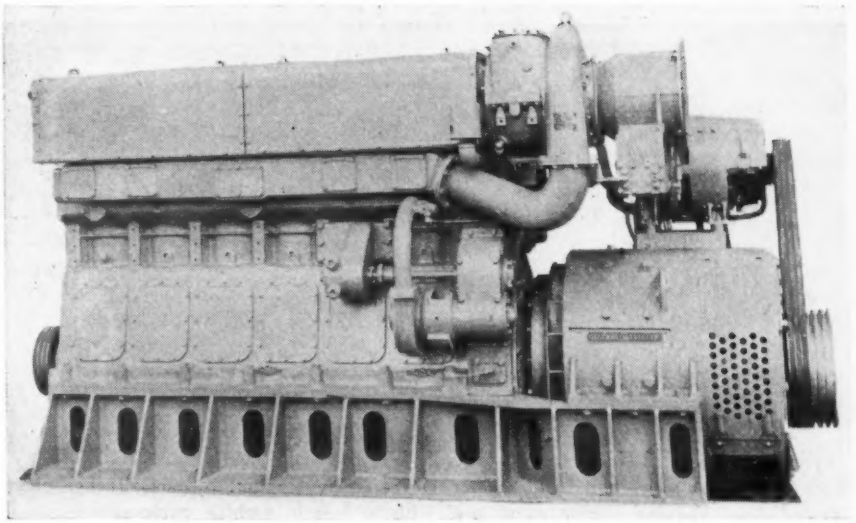


Fig. 3—On this engine, insulated exhaust pipes are carried inside another insulated box, an arrangement later abandoned in favor of water blanketing, Fig. 4

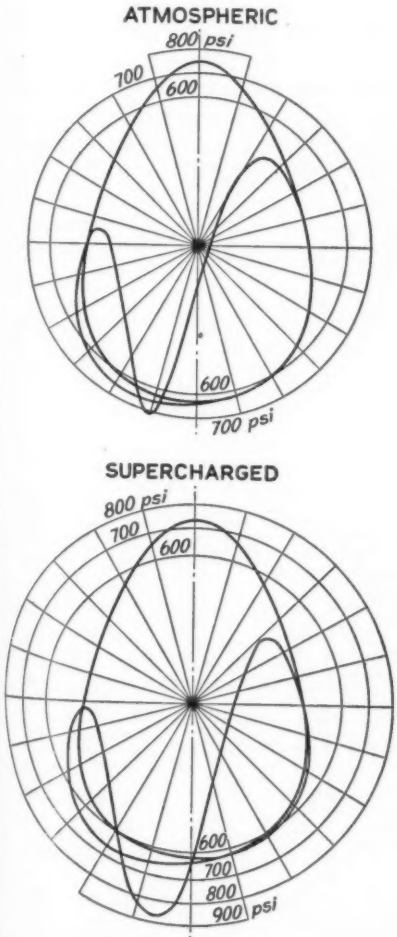


Fig. 2—Typical end main-bearing pressures in atmospheric, supercharged units

Variations in piston design between atmospheric and supercharged engines make it difficult to compare heat dissipation to lubricating oil but data from a large number of engines indicates that heat flow to the piston increases about in proportion to general heat dissipation although in some cases it is greater.

Fuel Consumption

Although tests of many engines reveal about 5% lower fuel consumption per hphr for supercharged engines, the *total* fuel consumption is, of course, much greater because of the increased output. Thus the fuel system itself must be designed to handle increased quantities and similar provisions must be made in fuel-handling equipment, such as supply pumps.

Other papers have covered the details of exhaust manifolding, including the subdivision essential to the Buchi system. The means of cooling the manifold, however, deserves some attention. Belief that the turbine needed all possible energy led to use of insulated manifolds in early designs. Experience proved that, in spite of insulation, heat rejection to the atmosphere was objectionable and that while maximum energy conservation is theoretically necessary actual amount of heat removed by cooling manifold is not of any serious consequence to the turbine and does not materially increase fuel consumption. In some cases, the entire insulated manifold assembly was placed inside another insulated box, Fig. 3. Heat rejection to the atmosphere still proved considerable and the arrangement made dismantling difficult.

To correct this situation the so-called water-blanketed manifold was developed, consisting of a water jacket around but not touching the exhaust pipes. The jacket picked up radiated heat, overcoming the objection of heat in the engine room. Turbine performance was essentially unaffected. Fig. 4 shows this type of manifold. Recent experiments on direct water cooling show somewhat higher fuel consumption and turbine performance not quite up to standard, but the effects are less detrimental than expected. However, water jacketing gains nothing over the water-blanketing arrangement and does considerably increase rate of heat rejection to the water.

Intake Manifolds

An intake manifold of adequate size for an atmospheric engine proves satisfactory for a supercharged engine, in general. Smooth turns with a minimum of abrupt direction changes are, of course, important in both cases.

All supercharging methods have been criticized from the noise aspect. With turboblowers, the air intake must be silenced to some degree, usually provided for in the blower itself. However, one of the most prolific noise sources proves to be the engine intake manifold into which the blower discharges. Manifold design is important; a round section is ideal and a cast manifold better than one of plate. However, for prac-

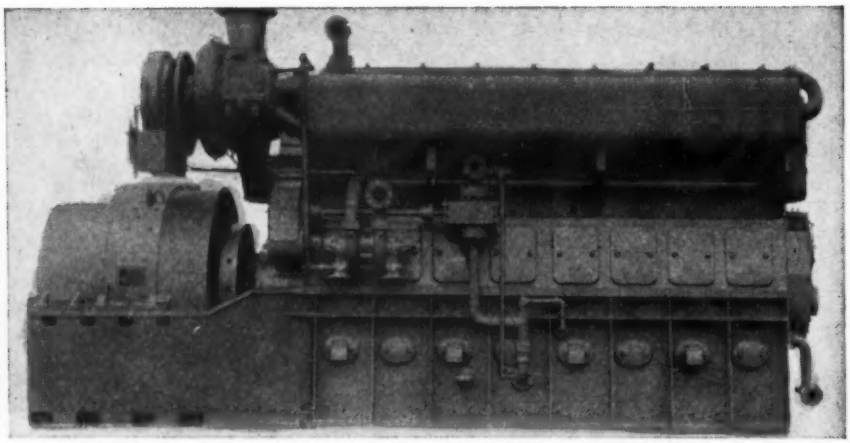


Fig. 4—Exhaust pipes run inside water jacket without actual contact. Jacket picks up radiation, keeping engine room cool without loss in turbine performance

tical reasons the manifold is usually made of welded steel and frequently cannot be round. Insulating material over the manifold proves effective in reducing sound level materially. With latest blower-impeller designs and insulation, the supercharged engine is not materially noisier than the atmospheric unit and from the exhaust-silencing standpoint the supercharged engine is greatly superior. In fact, exhaust noise from the turbine discharge is not especially objectionable and it is usually unnecessary to install silencers.

Speaking at the same session, L M Tichvinsky, vice-president in charge of engineering, American Bearing Corp, described diesel-engine bearing operation and failures, set forth progressive inspection methods and indicated rational bearing-maintenance methods. He pointed out that maximum pressures in such bearings are quite high because of high cyclic loads and that operation of the various bearings differs, depending on type and magnitude of load.

In piston-pin bearings, large peak forces in conjunction with small dimensions cause high maximum pressures, of the order of 6000 psi. Rocking motion of the connecting rod concentrates the load over a small arc, about ± 15 deg. Lubricating-oil temperature runs high because it is usually supplied through main and connecting-rod bearings successively. Piston-ring surfaces are hard, about 60 Rockwell C hardness at 150 kg load, and smooth, below 10 microinches. Clearances are small and successful operation depends greatly on damping properties of lubricating oil.

Loaded by gas, inertia and centrifugal forces, connecting-rod maximum pressures may reach approximately 3000 psi. Upper shell supports most of load in 2-cycle engines while both shells carry considerable load in 4-cycle units. Rotation of the crankpins provides some ventilation. Lubrication is usually supplied from the main bearing through bores in the crankshaft. Crankpin surface hardness varies from 200 to about 350 Brinell, depending on bearing material hardness, and surface finish should be as smooth as practicable. Clearances range from 0.0007 to 0.0015 in. per in., with smaller values in 4-cycle engines.

Main-Bearing Loading

Main bearings are loaded by gas, inertia and centrifugal forces, but larger dimensions result in more moderate maximum pressures, reaching about 1500 psi. The lower shell is usually more highly loaded. These bearings receive cool lubricating oil direct from heat exchanger and header. Main-journal hardness runs about the same as that of crankpins. Clearances range from 0.0008 to 0.0015 in. per in.

Table I—Chemical Composition Of Bearing Materials

	Cadmium-silver (SAE 180)	*Cadmium-nickel (SAE 18)*	*Copper lead*	*Lead-base babbitt (Navy 6)*	*Satco*	*Tin-base babbitt (Navy 2)*
Tin	0.01	0.10	...	5.00	1.00	88.0
Lead	0.02	0.01	25.0	80.0	98.0	0.35
Antimony	....	0.18	...	14.0	...	7.50
Copper	0.50	0.04	75.0	0.50	...	4.00
Cadmium	98.0	97.8	...	...	...	...
Silver	1.00	...	...	...	...	...
Nickel	...	1.80	...	...	...	...
Arsenic	...	...	...	0.20	...	0.10
Calcium	...	...	...	...	0.50	...
Aluminum	...	...	...	...	0.07	...
Zinc	0.02	...	...	...	...	...
Magnesium	...	...	...	...		
Iron	...	...	...	...	0.01	0.03
Others	Rem	Rem	...	Rem	Rem	Rem

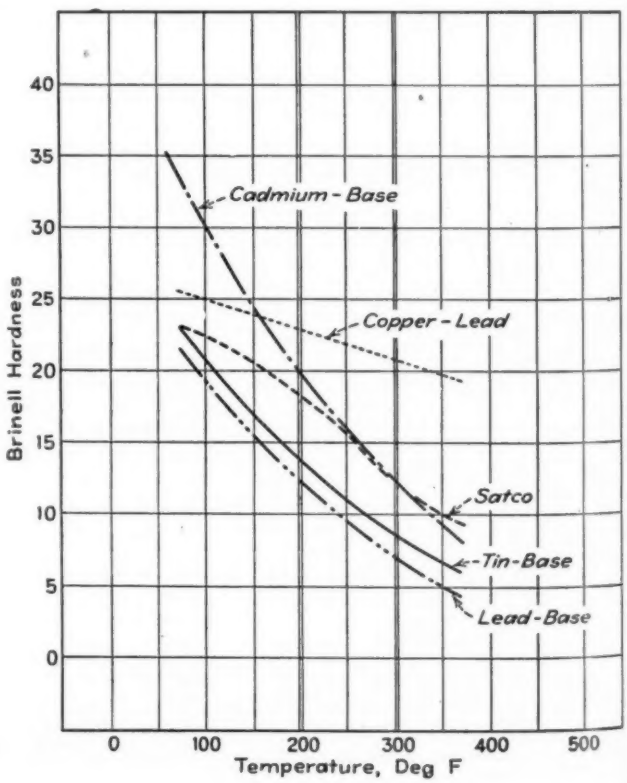


Fig. 5 (right)—Brinell hardness of bearing alloys plotted against temperature. Double lines indicate range of temperature usually encountered in the bearings of diesel engines

Failures may be caused by one or more of the following: (1) fatigue of bearing metal under high cyclic loads (2) excessive or insufficient hardness of bearing material (3) corrosion of bearing metal by lubricating oil (4) inadequate bond between bearing metal and shell (5) assembly errors (6) foreign particles (7) miscellaneous causes.

In heavy-duty bearings with cyclic peak loads, a definite area is pounded every cycle and if the physical properties of the bearing material, such as compressive strength and brittleness, are inadequate, fatigue failure may follow. Numerous small cracks, of mosaic pattern, are the first indication of fatigue distress. Under additional pounding the cracks will increase in number and size. Depth of cracks will also increase and may penetrate the entire bearing-metal thickness. In such cases, oil pressure may lift some sections, causing partial loss of bearing surface.

A bearing may be replaced if fatigue failure reduces its effective area by more than 10%. If careful inspection indicates that a bearing with fatigue failure may continue to operate, round off all sharp edges around the failed area with a scraper or electric iron to prevent additional breaking. Regular inspection is necessary to make sure failure is not progressing beyond the desired limits.

Table I gives chemical specifications of several heavy-duty bearing materials and Brinell hardness is plotted against temperature in Fig. 5. Brinell hardness is proportional to compressive strength. Temperature region of particular interest, between 200 and 300 F, is indicated by double lines. Too hard a bearing material may score the journal surface, but if too soft it may yield under pressure.

Bearing Corrosion

Corrosion of bearing alloys by chemical action of oxidized lubricating oils can usually be identified by rough and pitted surfaces. In most cases, corrosion occurs over small areas and is associated with high localized temperatures. Such corrosion may considerably decrease load-carrying surface and if effective surface is reduced to such an extent that wiping occurs, replacement may be required.

Poor bond between lining and shell, a rather frequent cause of failure, usually results from defective manufacture. Heat flow through a poorly bonded area is usually impeded and may lead to failure because of uneven and excessive surface temperature. Fatigue cracks over poorly bonded areas will loosen the lining quickly. In trimetal or "sandwich" bearings, composed of an 0.006 to 0.008-in. layer of tin-base or lead-base babbitt, an intermediate layer of bronze and a steel back, poor bonding may occur between inner and intermediate layers or between the latter and back.

Faulty assembly may take a number of forms. For example, mounting the upper grooveless shell in place of the lower shell completely interrupts oil flow. Excessive amount of lacquer on back of bearing indicates poor contact between bearing and cap. This usually considerably decreases normal heat flow and failure may occur.

Foreign, especially hard, particles may find their way into the bearing and score both journal and bearing surfaces. They will embed in soft, thick linings and become harmless but thin linings cannot fully embed large particles.

Miscellaneous causes of failure include defective manufacture, extrusion and wiping. Wiping not requiring bearing replacement is very common, especially during initial operation. Such wiped areas are not elevated over the bearing surface and are well-polished areas of indefinite, though oriented, shape.

Every bearing inspection, especially

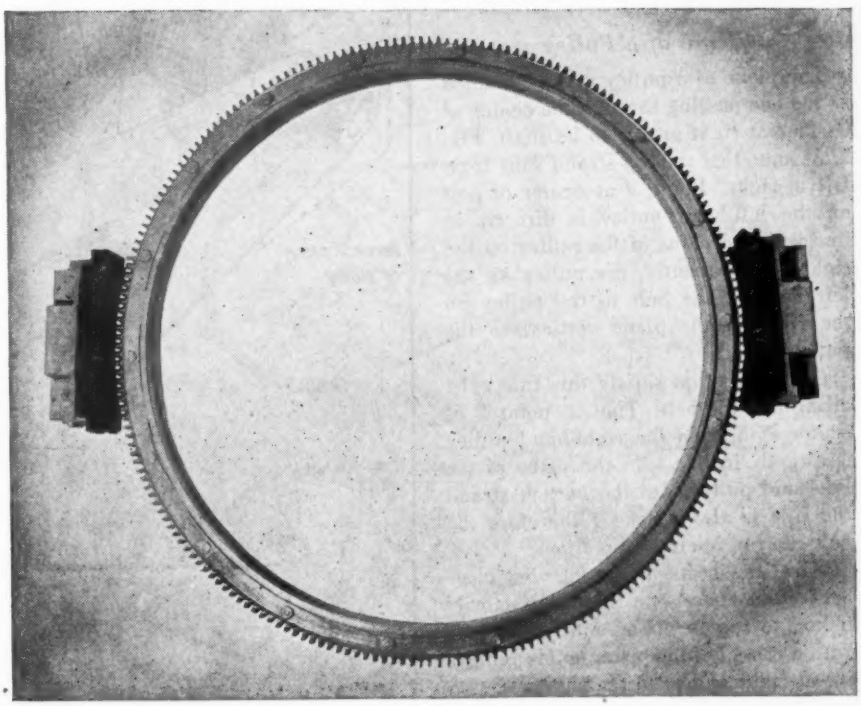
(*Continued on page* 160)

Electromagnetic Device Measures Turbine Torque

▶OUTPUT OF A TURBINE driving a generator can be determined accurately by measuring generator output and subtracting losses but this method proves impossible or at least inaccurate for units driving mechanical equipment or geared turbines. In such cases, turbine output must be determined directly, which assumes that both speed and torque are known.

Development of torque-measuring equipment is described in the *Brown Boveri Review*, Vol 31, Numbers 1/2. Such a device was first applied some time ago to a small steam turbine running at extremely high speed. More recently similar equipment was developed for large low-speed machines.

The new measuring equipment operates on the principle that when transmitting the turbine output the shaft is slightly distorted elastically in proportion to the torque and the distortion can be measured electromagnetically. The device can, of course, be employed to determine load on a turbine driving a generator and in certain special cases such a direct check may be desirable.



Elements of torque-measuring device: Under load, the turbine shaft distorts elastically in proportion to torque and distortion is measured electromagnetically

Guide Pulleys Provide Opposite-Rotation Short-Center Flat-Belt Drives

How to obtain opposite rotation of driving and driven pulleys on parallel shafts if center distance is too short for a crossed belt. Material from Power Transmission Council

▶When two parallel shafts connected by a flat belt on pulleys run in opposite directions, the usual arrangement is a crossed belt. Such drives, however, must have a fairly long center distance to prevent putting too short a twist in the belt and to keep the cross strands from rubbing too hard on each other. For short-center reverse drives several arrangements of guide pulleys have been successful.

When flat belts operate straight, or crossed on parallel shafts with suitable center distances, satisfactory operation requires only that the shafts be parallel and level and the pulleys in line. When guide pulleys are used we must observe the rule that the belt be delivered in the plane of the pulley toward which it is running. There is nothing mysterious about it. While we have not looked at it that way, the same rule applies in installing straight or crossed belts.

Plane of a Pulley

The plane of a pulley may be defined as the one passing through the center of its face at right angles to its shaft, Fig. 1. Assume that the top strand runs from left to right. Point *A* at center of belt on the left-hand pulley is directly in line with the plane of the pulley on the right. Consequently, the pulley on the left delivers the belt to the pulley on the right in the plane vertical to the pulley's shaft.

Conditions that satisfy this rule exist all around the belt. That is, point *B* at center of belt on the right-hand pulley is directly in line with the plane of the left-hand pulley. On the bottom strand the rule is also satisfied; therefore the belt can run in either direction.

Parallel shafts operating on close center distances can be satisfactorily belted to run in opposite directions, as with a cross belt, by using guide pulleys set at right angles to the shafts, Fig. 2. Such a drive must conform to the fundamental law explained in Fig. 1; namely the belt must be delivered in the plane of the pulley toward which it is to run.

In Fig. 2, for example, for the belt to operate in the direction shown, it is delivered from the left-hand side of driven pulley *C* to guide pulley *D*. To make this possible, the left-hand side of pulley *C* must be in a vertical plane, *F*, passing through the center of guide pulley *D* at right angles to its axis. Likewise, the far side of guide pulley *D* must be in a vertical plane, *G*, passing through the center of pulley *B*, as in Fig. 2A.

Pulley *B* must deliver the belt to guide pulley *E* in the vertical plane of that pulley as line *H*. From guide pulley *E* to driven pulley *C* the near side of pulley *E* must be in the vertical plane passing through the center of pulley *B*, as indicated by line *J*, Fig. 2A. However the right-hand side of pulley *C* does not have to be and is not in the vertical plane of pulley *E*. The drive can operate under this condition because the belt is being delivered from the far to the near side of pulley *E*.

Thus, the belt runs onto the four pulleys of the drive in the plane of the pulley that receives it, but may leave at an angle. Tracing the direction of the belt shows that the driven pulley turns opposite to the driver, the same as with a crossed-belt drive. Also the guide pulleys run in opposite directions, so that they must revolve on a fixed shaft.

Even though the pulleys are properly placed to receive the belt, sufficient space must be provided between the guide pulleys and the main pulleys to permit the belt to make a quarter turn.

Pulley and belt arrangement, Fig. 2 and 2A, works satisfactorily if the belt always runs in the direction indicated. If its direction is reversed the belt will run off the pulley because in reverse operation right-hand side of driven *C*

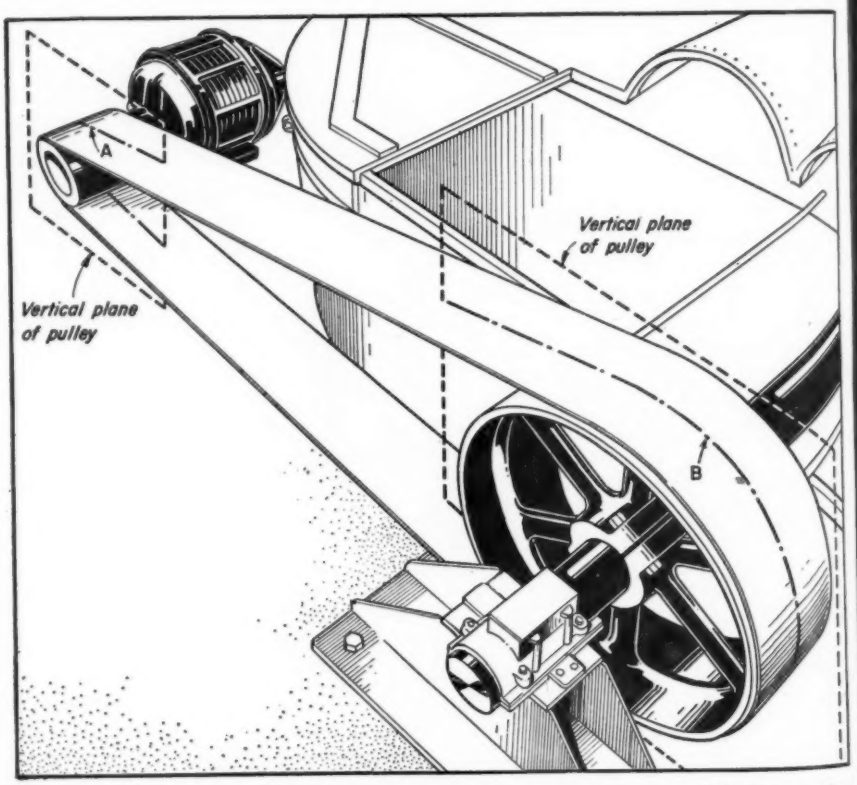


Fig. 1—A point in the belt's center on one pulley, as at *A*, is on a straight line passing through the plane in the center of the other pulley and at right angles to its shaft

delivers the belt to guide *E* at an angle to the plane of that pulley.

To operate a drive like Fig. 2 and 2A in either direction, guide pulleys must be set at an angle, as in Fig. 3 and 3A. Each guide pulley is fixed on its shaft that runs in two bearings. These pulleys are placed so that the vertical plane at right angles to their shafts is tangent to the face of the driver and driven pulleys. Assuming the same direction of rotation in Fig. 3 as in Fig. 2, the belt is delivered from the left-hand side of driven pulley *C* in a plane through the center of guide pulley *D* at right angles to its shaft. This condition is true of all four sections of the belt, Fig. 3 and 3*A*. If the belt's direction is reversed, the right-hand side of driven pulley *C* delivers the belt to guide pulley *E* in a plane through its center at right angles to its shaft. This is true for all sections of the belt; therefore it can run in reverse direction.

Success of this drive depends on proper mounting of the guide pulleys that are inclined toward each other. Guide pulley *D* is so mounted with respect to the two main pulleys that a plane passing through it at right angles to its shaft is tangent to pulleys *B* and *C*. The same applies to guide pulley *E*. Practical limitation of this drive is of one guide pulley interfering with another, which may occur when the driven pulley is considerably smaller than the driver and the center distance is short.

While not strictly angular drives, several arrangements for the transmission of power with flat belts between parallel shafts on short centers with the aid of guide pulleys are shown in Fig. 4 to 6. In these drives, as in the two preceding, the driven pulley revolves in opposite direction to the driver, as for a crossed belt. Guide pulleys *C* and *D* are usually made adjustable to take up belt slack.

The belt's tight strand, Fig. 4, is on the bottom and subjects guide pulley *D* to severe loading that may cause bearing trouble. Fig. 5 and 6 show modified arrangements of the drive, Fig. 4, where the direct belt pull is placed on the driven rather than on a guide pulley.

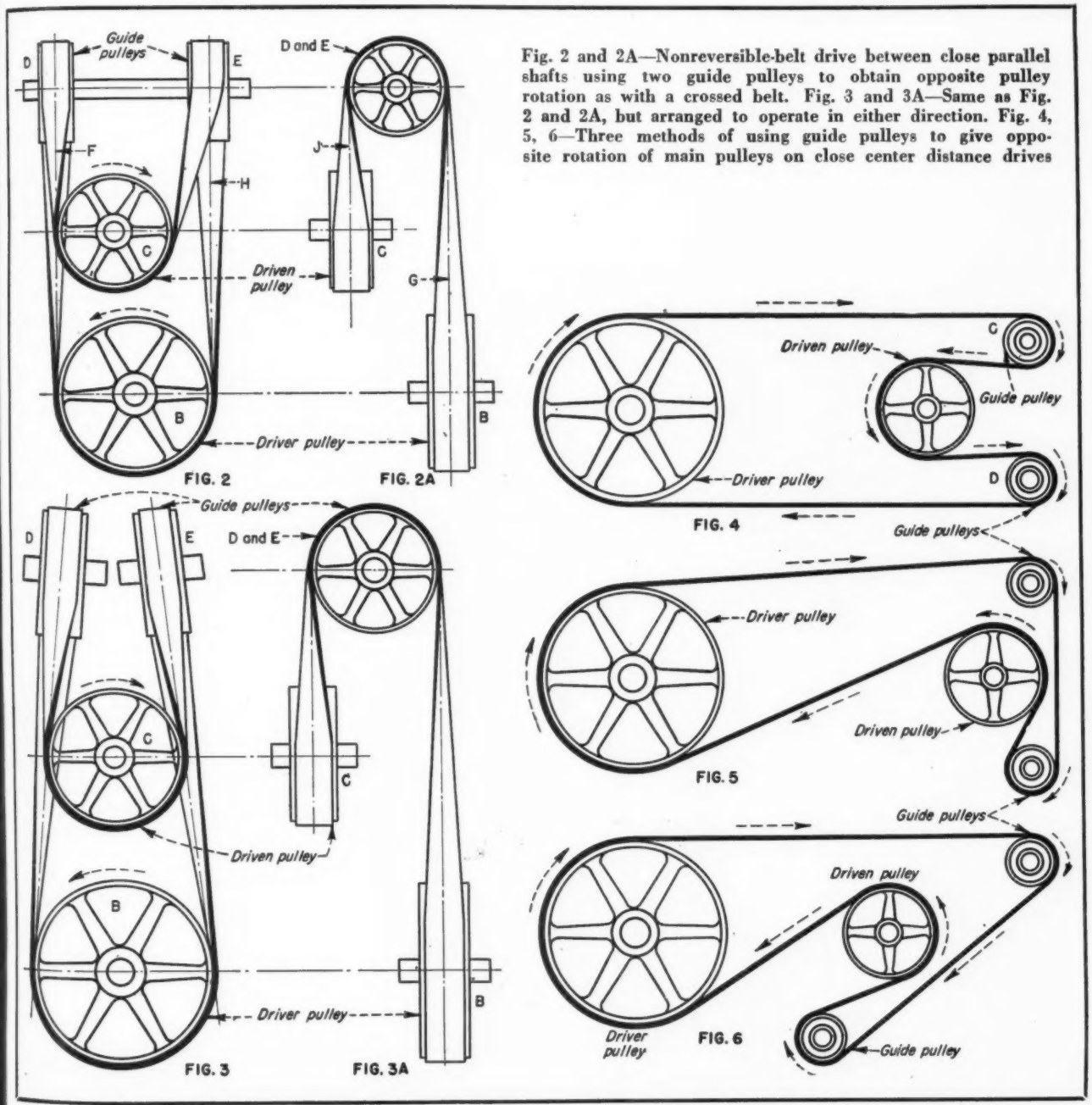
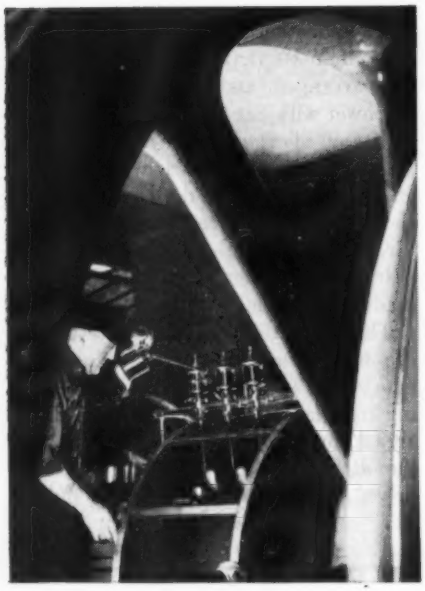


Fig. 2 and 2A—Nonreversible-belt drive between close parallel shafts using two guide pulleys to obtain opposite pulley rotation as with a crossed belt. Fig. 3 and 3A—Same as Fig. 2 and 2A, but arranged to operate in either direction. Fig. 4, 5, 6—Three methods of using guide pulleys to give opposite rotation of main pulleys on close center distance drives



FIVE STEPS TO GOOD LUBRICATION

Diagnosing lubrication troubles and preventing their occurrence requires five kinds of know-how relating to the mechanical equipment and to the lubricant. This article, and another to follow, outlines these fundamentals for practical engineers

By BEN F HUNTER
Consulting Engineer, Honan-Crane Corp, Subsidiary of Houdaille-Hershey Corp

▶ To DIAGNOSE LUBRICATION difficulties correctly and, more important, to so handle lubrication and maintenance of mechanical equipment that such difficulties do not occur requires a working knowledge of five fundamentals: (1) characteristics of the equipment involved (2) design features of lubricating devices or systems (3) composition and chemistry of petroleum lubricants, what happens to them in service, and modern methods of maintaining or restoring their condition (4) proper application of the correct amount of the best lubricant for a specific requirement and (5) nature and effects of the catalytic reactions of metals and petroleum lubricants.

Any one or all of these basic factors can influence successful operation and maintenance of mechanical equipment. Without a general knowledge of their importance it is difficult to trace the cause of any trouble.

Regardless of the original cost of a specific mechanical unit, how well it has been constructed, material of which it is made, or precision of the workmanship, its satisfactory operation depends on an adequate, uninterrupted supply of the proper lubricant, maintained as nearly as possible in its original condition and purity.

Considering the first of the five fundamentals of good lubrication, the need for a knowledge of equipment characteristics is obvious. The operator should in all instances acquire complete familiarity with equipment design and operation to enable him to detect readily by sound, vibration, temperature rise or general behavior of the machine when something has gone wrong.

The operator deals in the main with equipment "as is." Many so-called lubrication problems could have been eliminated on the drafting board if the designer or builder had given more consideration to the characteristics of lubricants and lubricating devices. However, careful study of mechanical equipment in service reveals in far too many instances a lack of such consideration. In this advanced mechanical age the advantages of automatic application of proper oil or grease to bearings or parts needing lubrication should be universally recognized and incorporated in designs. While responsibility for suitable lubrication systems rests with the designer and builder, the operator plays a part in insuring successful operation by giving this factor due weight when selecting equipment.

BEN F HUNTER became consulting engineer for Honan-Crane on Jan 1, 1945, after 19 years as chief lubrication engineer for Gulf Oil Corp and six years as general industrial lubrication engineer for the Texas Co.

His engineering background: 1907-08, Pople Bros, building contractors; 1909-11, engineer on powder-plant construction, E I DuPont de Nemours; 1911-12, construction of power plants, high lines, street railways for Federal Light and Traction Co; 1913-14, engineer in charge of construction, Cement Securities Co; 1915-1920, sales engineer, Mine & Smelter Supply Co; 1920-26, general industrial lubrication engineer, Texas Co; 1926-45, chief lubrication engineer, Gulf Oil Corp and Gulf Refining Co

Lubricant Properties

Having the necessary familiarity with equipment characteristics and being assured of adequate design from the lubrication standpoint, the operator needs next a working knowledge of lubricant properties. Petroleum forms the source of most present-day lubricants because it (1) provides the best all-around products (2) is available throughout the world in sufficient quantities to meet the demand and (3) can be refined and supplied at low cost.

Petroleum is a highly complex mixture of the elements hydrogen and carbon with occasional but limited percentages of oxygen, sulphur and other elements occurring as impurities. The

source of petroleum is not a subject for detailed discussion here. Briefly, scientists in general agree that decayed animal or vegetable matter formed its probable source. Stored beneath the earth's surface for unnumbered centuries, the elements of hydrogen and carbon came into contact and under the influence of time, temperature, pressure and the catalytic effect of other elements formed molecules having different numbers of carbon and hydrogen atoms. Number of carbon atoms per molecule may vary from one to 70 or more, with twice that number of hydrogen atoms or less, depending on the molecular structure of the particular hydrocarbon.

As it occurs in nature, petroleum may be suitable only as a fuel. To separate crude oil into its many hundreds of useful products, elaborate and complicated refining or manufacturing processes are employed, the merits of which cannot be covered here. Any modern refining process can produce products of good quality. In effect, all processes do the same job: they divide the crude oil, containing a vast array of hydrocarbons of different structure and properties, into groups whose hydrocarbons are more nearly similar in structure and properties. Depending on their nature, these refined products find use as fuels of various kinds, lubricants, raw materials for chemical processes, etc.

Petroleum Hydrocarbons

As mentioned above, petroleum hydrocarbons may vary from one to 70 in the number of carbon atoms per molecule. The smaller the number of carbon atoms per molecule, the lower the boiling point, flashpoint and viscosity; conversely, the greater the number of carbon atoms the higher the boiling point, flashpoint and viscosity.

For this discussion, it may be assumed that hydrocarbons with eight or fewer carbon atoms per molecule are gases at normal temperature. Those with more than eight carbon atoms are normally liquids. In general, therefore, all refining processes involve the separation of various hydrocarbons with relation to their boiling points. When separated, the various petroleum fractions are subjected to specific chemical treatments. The chemical or physical treatment involved classifies the specific refining process.

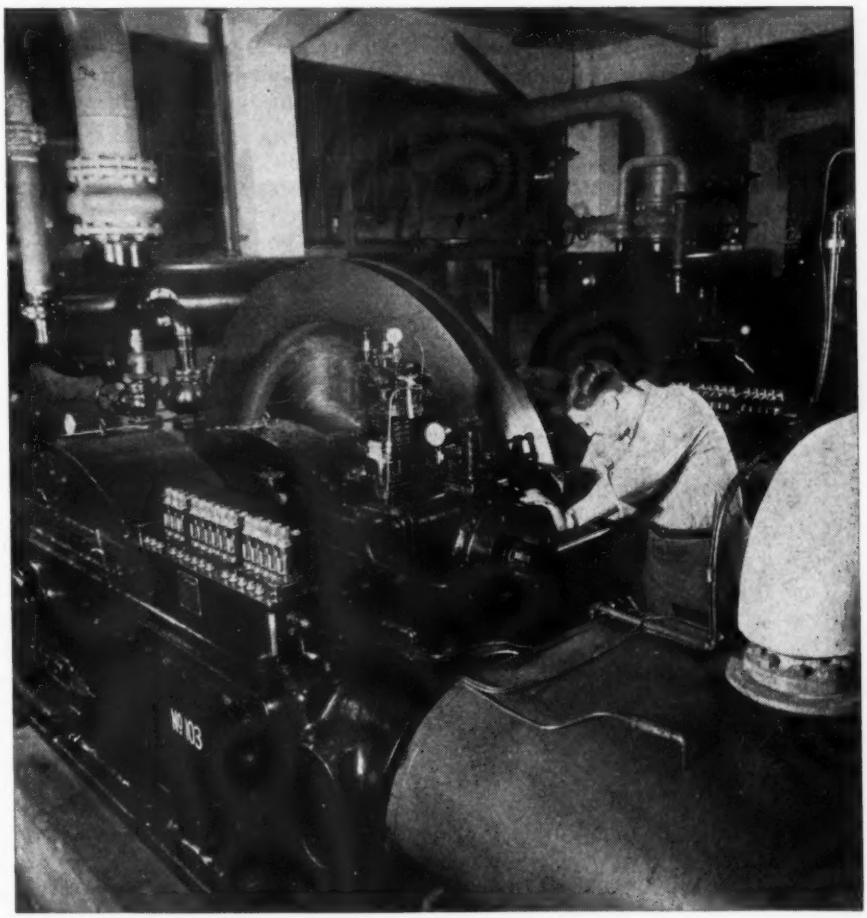
For those not familiar with petroleum chemistry, it may be stated that crude oil is divided into three general classifications: paraffinic, naphthenic and mixed base. To the trained petroleum scientist, the term *paraffinic crude* indicates hydrocarbons predominantly of the straight-chain type. The term *naphthenic crude* indicates that the hydrocarbons are predominantly of the ring-chain variety. A *mixed-base crude* is a mixture of both straight-chain and ring-chain hydrocarbons.

The layman hears the term *paraffin* oils, sometimes referred to as *paraffin-base* or *eastern oils*, and the term *naphthenic* oils, sometimes referred to as *asphaltic, coastal* or *western* oils. Many claims are made for the merits of a paraffin-base oil or an asphaltic base oil for specific uses. This is an involved and controversial subject. However, it may be stated definitely that high-quality lubricants can be and are being manufactured from all types of crude petroleum. Ample performance records of lubricants made from various types of crudes are found throughout industry. Choice of an oil of specific type may represent individual preference.

Petroleum is, perhaps, the most complex compound with respect to molecular structure known to science. In forming hydrocarbons, nature took full advantage of the mathematical possibilities, and authorities agree that hundreds of thousands, perhaps millions, of hydrocarbons exist in petroleum, each with its own molecular structure. Each has its individual stability or resistance to chemical change when subjected to the many influences with which it comes in contact during its useful life as a lubricant.

For example, petroleum, like all matter, is subject to decomposition or chemical change, influenced by a number of factors, of which the most important are: (1) temperature (2) oxygen and (3) catalytic influence of other elements. Obviously, it is impossible to eliminate all these influences completely in the operation of mechanical equipment, but with a more thorough knowledge of their importance, manufacturers and operators may eliminate many troublesome conditions and improve operation.

In service, petroleum suffers decomposition or chemical change in direct ratio to temperature. Petroleum hydrocarbons with the greatest resistance to chemical change prove remarkably stable at temperatures below 140 F. Above this temperature, stability or re-



Successful lubrication depends on a thorough and sound knowledge of the characteristics of the equipment involved and assurance that the designer and builder have provided lubrication facilities suitable to the conditions of the unit's operation

sistance to chemical change decreases about 50% for each 18-F temperature rise. For example, if the life in days, months or years of a specific lubricant in a particular unit operating at 140 F is known, the useful life would be only one half as long if temperature increased to 158 F and one fourth if it went to 176 F.

When this important factor influencing the useful life of petroleum lubricants is fully appreciated, the necessity for temperature control becomes evident and should be recognized by both designers and operators.

Usually, in operation of mechanical equipment it is not possible to prevent air, the source of oxygen, from coming in direct contact with the lubricant but in all instances avoid unnecessary or excessive aeration of oil, particularly in bath or circulating systems. When oxygen attacks or combines with hydrocarbon, organic acids form which were not present in the original lubricant. Organic acids thus formed fall into two general classes: (1) low-molecular-weight low-boiling-point or volatile acids and (2) high-molecular-weight high-boiling-point acids.

The low-molecular-weight or low-boiling-point acids are highly corrosive to ferrous metals and may be the principal cause of corrosion of machine parts or the metals of the oiling system above the oil level. Corrosive effect becomes more pronounced in the presence of moisture. Forced-circulation of air above oil level in tanks of oiling systems where corrosive volatile acids could be trapped forms the best remedy for corrosion.

Uncontaminated petroleum lubricants are noncorrosive to ferrous metals but often corrosion resulting from moisture or volatile organic acids formed by oxidation is wrongly blamed on the oil.

High-Boiling-Point Acids

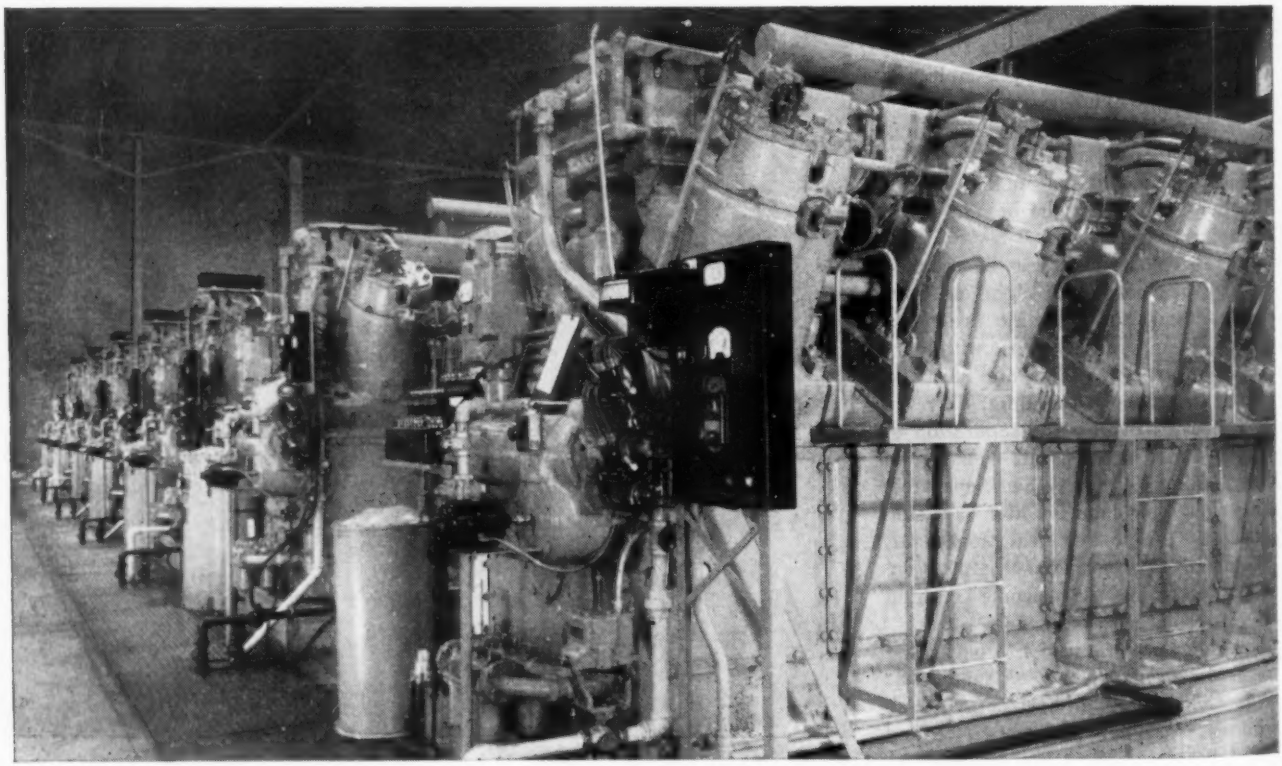
The high-molecular-weight or high-boiling-point organic acids formed by oxidation of petroleum lubricants are in themselves good rust preventives. Gums or so-called lacquers or sticky deposits precipitated from lube oil and observed on the surface of machine parts may consist largely of high-molecular-weight organic acids formed in service.

Appreciable percentages of organic acids formed by oxidation are soluble in the unoxidized or unaffected portion of the lubricant. Most of the volatile organic acids are driven off when the temperature of the oil bath equals the boiling point of the particular acid. The high-molecular-weight or high-boiling-point acids soluble in the oil will precipitate to a greater or less degree as temperatures increase or decrease. That is, precipitation will be pronounced throughout the system at either the hot spots or the low-temperature points, such as coolers.

Formation of organic acids in lubricating oils continues progressively, and when a given percentage has been created in the oiling system and precipitation or corrosive effect has reached a point where it is detrimental and the lubricant is considered unsatisfactory for further service, it must be purified or removed and new oil added. The percentage of organic acids sufficient to render a lubricant unsatisfactory for continued service may be very small, perhaps not more than 5%. Thus, although 95% of the oil may be in its original condition, the presence of a small quantity of contamination requires destruction of the whole. This waste of good oil can be avoided by adequate, continuous and proper oil purification to remove contamination as it occurs and keep the lubricant at maximum effectiveness.

Oil-purification systems for maintaining lubricants in their original condition should be selected in accordance with the nature of the contaminants to be removed. Therefore, a careful analysis to determine the source of contamination should be made before selecting the purification system.

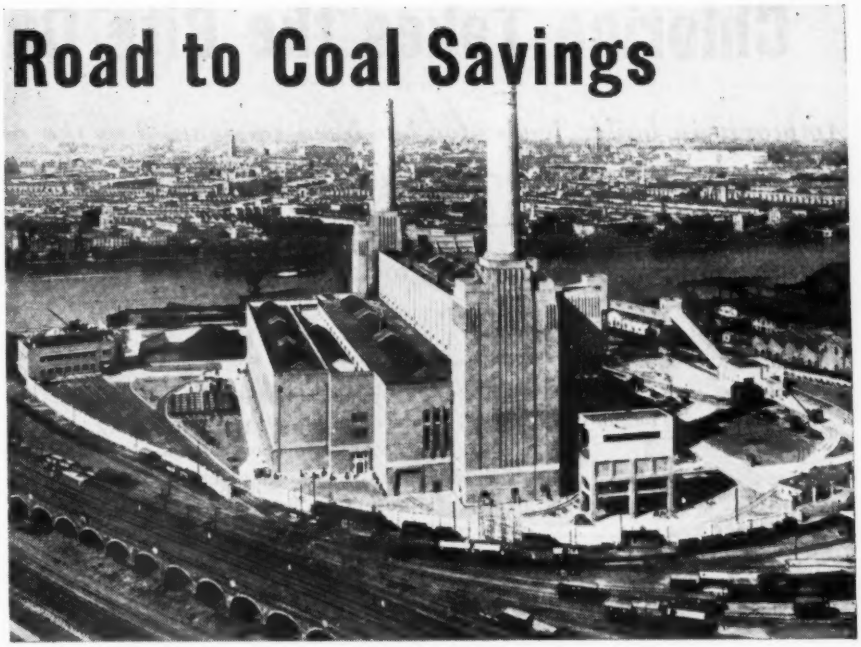
An article to follow will discuss the catalytic effect of metals and methods of oil purification.



Lubricating-oil purification equipment such as serves these large gas engines in a Southwestern aluminum plant should be selected only after careful analysis determines the source and nature of the contamination to be removed

Britain Points Road to Coal Savings

Under grim necessity's lash an active Ministry of Fuel and Power guided Britain in saving a lot of coal. These fuel-front notes can help us overcome wartime coal shortages



From the large central station, like London's Battersea plant (above) to the smallest industrial, fuel-saving has been the wartime watchword of British engineers

▶ WHAT THE WAR DID to the traditional British way of life is now common knowledge, although most Americans find it hard to grasp the full extent of the adjustments forced on the average Englishman by this war.

For one thing, there was a tremendous drive to save fuel. The results were outstanding. Here is a report from an English manufacturer: "Coal consumption: 1st quarter, down 20%; 2nd quarter, down 27%; 3rd quarter, down 28%; 4th quarter, down 22%. Production substantially the same as previous years. Reasons for reduced consumption: necessity of making three tons of coal do the work of four; the expert assistance of industrial community fuel watchers, together with the printed-pamphlet advice of the Ministry of Fuel; the cooperation of management, employes and heating-plant operators."

An immense amount of work has been done in industry to increase fuel efficiency. Much of this will have a long-term value. Never before has a British government department set up an organization of power experts to visit large consumers' premises to show them how to effect savings with no loss in production efficiency.

Waste Formerly Common

Long years of cheap and abundant coal supplies in England had led industry to regard fuel as an insignificant part of total manufacturing costs. Fuel waste had been regarded as a natural accompaniment of industrial activity.

All this is changed today. For example, a single Fuel Efficiency Committee set up under the direction of one of the Ministry's regional controllers sent experts on over 470 visits to 168 industrial concerns in one area. All firms were visited at least twice. Some 130 ways by which heat from coal, coke, oil or gas had been seen going to waste were listed, and more than 1000 recommendations were made for stopping waste.

Total coal consumption in these 168 industrial concerns, excluding public utilities, is over 130,000 tons per year. At least 15,000 tons could be saved out of this total by adopting the experts' suggestions.

This kind of work is going on all over Britain—work to which the utility industry is lending many of its trained workers. It is supplemented by lectures to operatives on boilerhouse management, by meetings to discuss steam utilization and other appropriate matters, by "fuel flashes" on internal broadcasting systems, and by the display of industrial fuel economy exhibits and posters supplied by the Ministry, and by such moving pictures as "Better Boiler Practice."

Special pamphlets, widely distributed, include the following subjects: Heat Insulation, Emergency Memorandum on Steam Production and Consumption. Correct Methods of Condensate and Air Removal. How to Make the Best Use of Condensate, Practical Economy Points for Industrial Gas Users, How to Make a Simple Steam Meter for Use in Factories. The Appointment and Responsibilities of Fuel Watchers, Bonus Schemes for Fuel Economy in Industry, Combustible Material in Ashes, Control of Excess Air in Steam Raising and Central Heating Plants, Thermostatic Control for Hot Water and Steam, Operation and Maintenance of Gas Burners, Fuel Economy by Saving Electricity, Thermal Insulation of Buildings, The Effect of Variations in Output on Heat Consumption, Superheated Steam, The Insulation of Furnaces, Cooling Firebars in Industrial Furnaces and Boilers, The Construction of a Factory Heat Balance, Utilization of Steam, Heavy-Oil Engines, The Industrial Use of Liquid Fuel, and others pertinent to greater fuel efficiencies.

Any of these pamphlets can be had for a few cents by writing to Sales Dept, British Information Services, 30 Rockefeller Plaza, New York, N. Y.

Cooperative Efforts

Many manufacturers have received much help from the fuel watchers and the educational work carried on by the Ministry of Fuel and Power. Enlisting the cooperation of shop stewards and the appointment of fuel watchers have proved valuable means of attaining desirable results in industry.

Editor's Note: In the U.S., the National Fuel Efficiency Program, in cooperation with Dept of the Interior, Bureau of Mines, is trying to accomplish similar results with industry. If America is to match England's wartime fuel-saving achievements, industry should give every cooperation and assistance to Thomas C Cheasley, supervising engineer of the National Fuel Efficiency Section. It is only by conservation and increased fuel efficiency that we can balance production and consumption of coal this year.

Chlorine Takes the Bite Out of Ammonia

Ammonia in boiler feedwater has been recognized as the cause of strain cracking in brass condenser tubes and brass equipment in noncondensing steam systems. It also causes severe corrosion in piping and valves and encourages bacteriological fouling of heat exchangers and distribution lines. Tests show that when properly applied, chlorine destroys ammonia*

By A E GRIFFIN
Wallace & Tiernan Co, Inc

► AMMONIA REMOVAL from domestic water is incidental to the destruction of bacteria, but in industrial and power plants its removal assumes considerable importance. Here the water's ammonia content, rather than being a pollution index, is looked upon as a measure of its corrosiveness and effect on slime growth. Thus for economic reasons the quantity that can be tolerated is limited.

Ammonia is ordinarily present in water as (1) free ammonia (NH_3-N) and (2) albuminoid ammonia. These forms may exist in almost any ratio to each other. Free ammonia is the most troublesome because it easily passes along with steam and concentrates in the condensate. Albuminoid ammonia, on the other hand, consists largely of organic-bound nitrogen that must be subjected to special conditions before decomposition takes place.

Significance of ammonia in water depends to a large extent upon the amount present, its form and the intended use of such water. Before 1918, for instance, most sanitation engineers relied to a great extent upon the concentration of free and albuminoid ammonia and other forms of nitrogen in their interpretation of the sanitary quality of water. Recent improvements in bacteriological tests attracted more attention to the bacteria content and less to the ammonia. They did not consider its removal either practicable or desirable. On the contrary, many operators felt that ammonia might be beneficial because it combined with chlorine to form chloramines: Some even went so far as to add a small amount because they felt that the presence of chloramines helped obtain persisting chlorine residuals in the distribution system and affected better bacteriological destruction without intensifying odors.

More recently, particularly since 1939, tests and experience show that free available chlorine residuals can be obtained without intensifying tastes and odors and that such residuals kill practically all kinds of bacteria in less than three minutes. Furthermore, maintaining such a residual guarantees that the majority of free ammonia originally present has been destroyed because free-chlorine and free-ammonia residuals do not normally exist in the same solution. Thus the control known as *break-point chlorination* can be used to destroy ammonia as well as bacteria.

Test Procedure

Several other methods of removal are already in use but it is only lately that chlorine has been used in this connection although, as early as 1927, F E Hale proved that chlorinated sewage loses its nitrogen content provided the ratio of ammonia to chlorine is 1:7.5, or more.

Repeated evidence of loss in residual chlorine and ammonia led to our making tests with distilled water containing 0.50

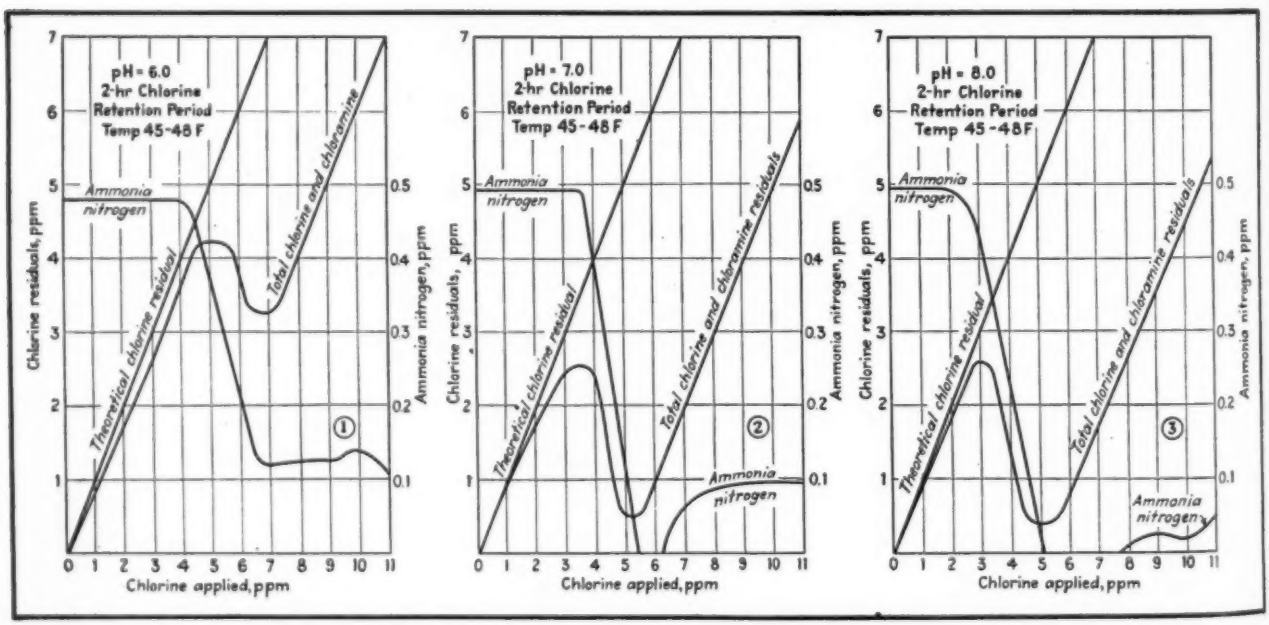


Fig. 1, 2 and 3—The break in the residual-chloride curve increases considerably in magnitude with increase in pH of the water. Ammonia-nitrogen either disappears entirely or reaches minimum value at the point of minimum chlorine residual

* *Abstract of a paper delivered at The 5th Annual Water Conference, Engineers' Society of Western Pa., Oct 30, 1944*

ppm free ammonia and buffered to pH values of 5.0, 6.0, 7.0, 8.0, and 9.0, as outlined by W M Clark.

The samples, adjusted to desired pH and ammonia content, were distributed into a series of gallon containers immersed in a running-water bath at a temperature of 45 to 48 F. Chlorine, as chlorine water, was then added to each bottle in the following concentrations: 0, 0.2, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0 and 11.0 ppm. We carefully added sufficient buffer to prevent any appreciable drop in pH regardless of the amount of chlorine added. Chlorine residual was determined on the various samples after 20-min, 2-hr and 24-hr retention periods by the modified starch-iodide method. Ammonia-nitrogen determinations were made after the 2- and 24-hr chlorine-retention periods. All pH determinations were made on a glass electrode. Temperatures were held constant and tests made in subdued light.

At the end of the specified periods excess chlorine in 500-ml portions of a sample was neutralized with sulphurous acid, and ammonia-nitrogen determinations made. Sulphurous acid was chosen rather than sodium thiosulphate, because we could not obtain check results with the latter and also in recognition of F Raschig's statement that monochloramines are reduced to ammonia-nitrogen by sulphurous acid, and the work of C T Dowell and W C Bray, indicating that of the many reducing agents tried on nitrogen trichloride only the sulphites reduced it quantitatively to ammonia-nitrogen (other reducing agents appearing to produce some nitrogen gas).

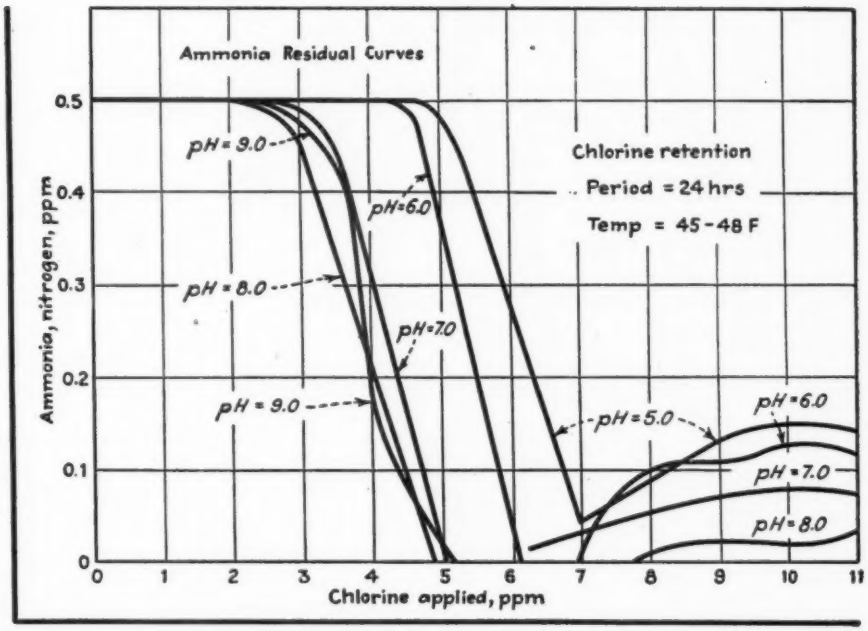


Fig. 7—Maximum ammonia removal occurs at the point of minimum residual beyond the hump. No loss in nitrogen occurs until chlorine residual reaches its maximum

The pH of all sample portions was adjusted to 7.0-7.4 prior to distillation which followed the method prescribed in "Standard Methods for the Examination of Water and Sewage." Using Nessler's reagent, ammonia content was determined on the measured portion of each distillate, developed color in the distillate being compared with known standards.

At pH 5.0, the *break* in chlorine residual is so ill defined, that in practice it might be passed over without serious consideration. That it is the true break is substantiated by the loss in ammonia-nitrogen residual as chlorine applications were increased beyond 6.0 ppm.

The *break* in the residual curve increases considerably in magnitude when pH is increased to 6.0, Fig. 1. Under the latter condition residual at the top of the hump drops from 5.35 at pH 5.0 to 4.20 ppm at pH 6.0, and the residual at the bottom of the break drops from 5.2 to 3.22 ppm. Likewise, considerably more ammonia-nitrogen is removed than at pH 5.0. Increasing the pH to 7.0 produces further losses in residual chlorine

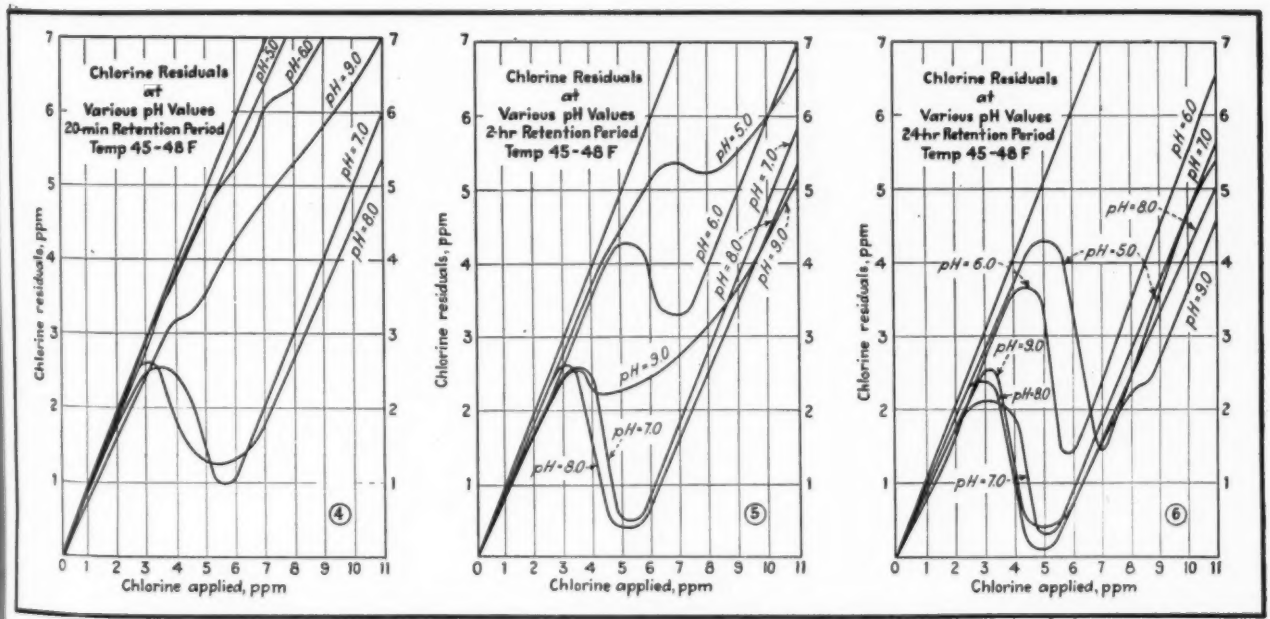


Fig. 4, 5 and 6—Reactions involved in chlorine treatment depend on time of contact as well as water pH. Formation of chlorine break point and removal of ammonia progresses rapidly within 20 min and apparently reaches completion after 2 hr

and ammonia-nitrogen with the latter disappearing entirely at the point where chlorine residual falls to a minimum, Fig. 2. Further increasing the pH to 8.0 had little effect on the residual curve, although it did result in removing considerably more ammonia-nitrogen, Fig. 3, than had been accomplished at any of the prior pH levels.

At pH 9.0 the ammonia-nitrogen residuals, instead of disappearing at the point of minimum chlorine residual, decrease in a smooth curve beginning at the point of maximum residual at the top of the hump, and ending in the no-ammonia residual at the 11.0-ppm chlorine point. Under this condition (pH 9.0) the chlorine curve, instead of approaching zero at the break, reversed its former trend, forming a break at a residual of 2.20 ppm.

Test Results

These results led to the conclusion that under test conditions the optimum pH for maximum chlorine and ammonia removal lies between pH 7.0 and 8.0. Plant-scale experience, however, indicates that this range may be increased to 6.5 to 8.5.

R M Chapin and others, working with relatively high chloramine concentrations (1000 to 2000 ppm), demonstrated that it required a ratio of nitrogen to chlorine of 1:7.5 to remove the ammonium ion completely. However, when using a dilute solution (±70 ppm) this ratio changed to 1:8.5. In our experiments we found this ratio to be close to 1:10 as evidenced by Table I. This ratio, however, is good only for distilled water under conditions previously described. In practice, because of variations in amounts and types of impurities, temperature and contact, the ratio usually deviates considerably from this figure. Values of 1:15 are frequent and ratios of 1:25 are not uncommon.

So far we have discussed the effect of but one retention period with ammonia and chlorine. Fig. 4, 5 and 6, show the residuals for all pH values studied at 20-min, 2-hr and 24-hr contact. These indicate that the reactions involved depend upon time as well as pH. There was little loss of chlorine after 20-min contact at pH 5.0, Fig. 4, with the result that this chlorine-residual curve shows little semblance to a break-point curve. At the end of 2 hr, Fig. 5, enough loss in chlorine was recorded to produce the outline of a break point, and when 24 hr had elapsed, Fig. 6, the reactions had progressed far enough to produce a typical break-point curve.

Although less chlorine was lost over the 24-hr period at pH 5.0 and 6.0 than at pH 7.0, 8.0, and 9.0, it seems reasonable to assume that, had the experiment been extended another 24 hr, the residual curves at all pH values would have closely approximated each other. On the other hand, formation of the break-point at pH 7.0 and 8.0 had progressed rapidly within the first 20 min and had apparently reached completion after 2 hr. These results (Fig. 4, 5, 6 and 7) suggest that formation of the break point and removal of ammonia requires at least 20 min at pH 7.0 and 8.0 and up to 24 hr for the other pH values studied. They further suggest that the optimum pH for reaction between chlorine and ammonia lies in the neighborhood of 7.0 to 8.0.

Fig. 7 shows that pH is a function of ammonia removal. Maximum removal always occurs at the point of minimum residual beyond the hump. Here there is no loss in nitrogen until chlorine residual reaches its maximum. From this point on, nitrogen as well as chlorine decreases rapidly with increasing chlorine dosage until slightly more than 5.0 ppm has been added. At that point, chlorine residual falls to a minimum, and the nitrogen entirely disappears. With increased chlorine feed, the residual curve rises in direct proportion to the dosage curve, and slight amounts of nitrogen reappear.

Experiments indicate that this is caused by traces of nitrogen trichloride which, in practice, could escape by aeration during the passage of water through a plant. The analytical procedure used evidently reacted upon the latter compound in such a way that the nitrogen became recoverable. This is further evidenced by the fact that nitrogen trichloride can occasionally be formed in water for an indefinite period following break-point chlorination. The removal of this nitrogen trichloride by aeration makes ammonia removal possible in less than 20 min by chlorinating beyond the break point.

A study of the reaction at the point of ammonia and chlorine disappearance indicates that chloramines are first formed. Any excess chlorine then reacts with the chloramine and both are destroyed. This is somewhat at variance with the opinion of J R Rossum who feels that the mono-chloramines react with di-chloramines until each is destroyed. His theory assumes that the residuals at the break point are composed entirely of chloramines whereas the work of F J Hallinan shows the presence of free chlorine ahead of, as well as beyond, the break point. That chlorine predominates beyond the break point has also been shown by W A Moore in tests conducted by him.

Chlorine Control

Chlorine feed for ammonia removal can be controlled by the Laux Flash Test—an adaptation of the well-known ortho-tolidine test. It places emphasis on the speed of yellow color production following the addition of ortho-tolidine. When 85 to 100% of the full color develops instantly, sufficient chlorine has been added to pass the break point; this is the control point. Quite often the magnitude of this residual averages between 1.0 and 2.0 ppm or more when sampled close to the point of application. Maintaining this relatively high residual in the early part of the removal

(*Continued on page* 144)

Table I—Two-Hour Contact of Chlorine and Ammonia

pH	*Ammonia nitrogen consumed ppm*	*Chlorine consumed ppm*	N_2:Cl_2 *ratio by weight*
6.0	0.361	3.64	1:10.08
7.0	0.495	5.00	1:10.12
7.5	0.500	5.04	1:10.08
8.0	0.490	4.69	1: 9.54
Av.	0.461	4.59	1: 9.96

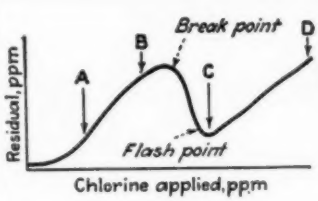
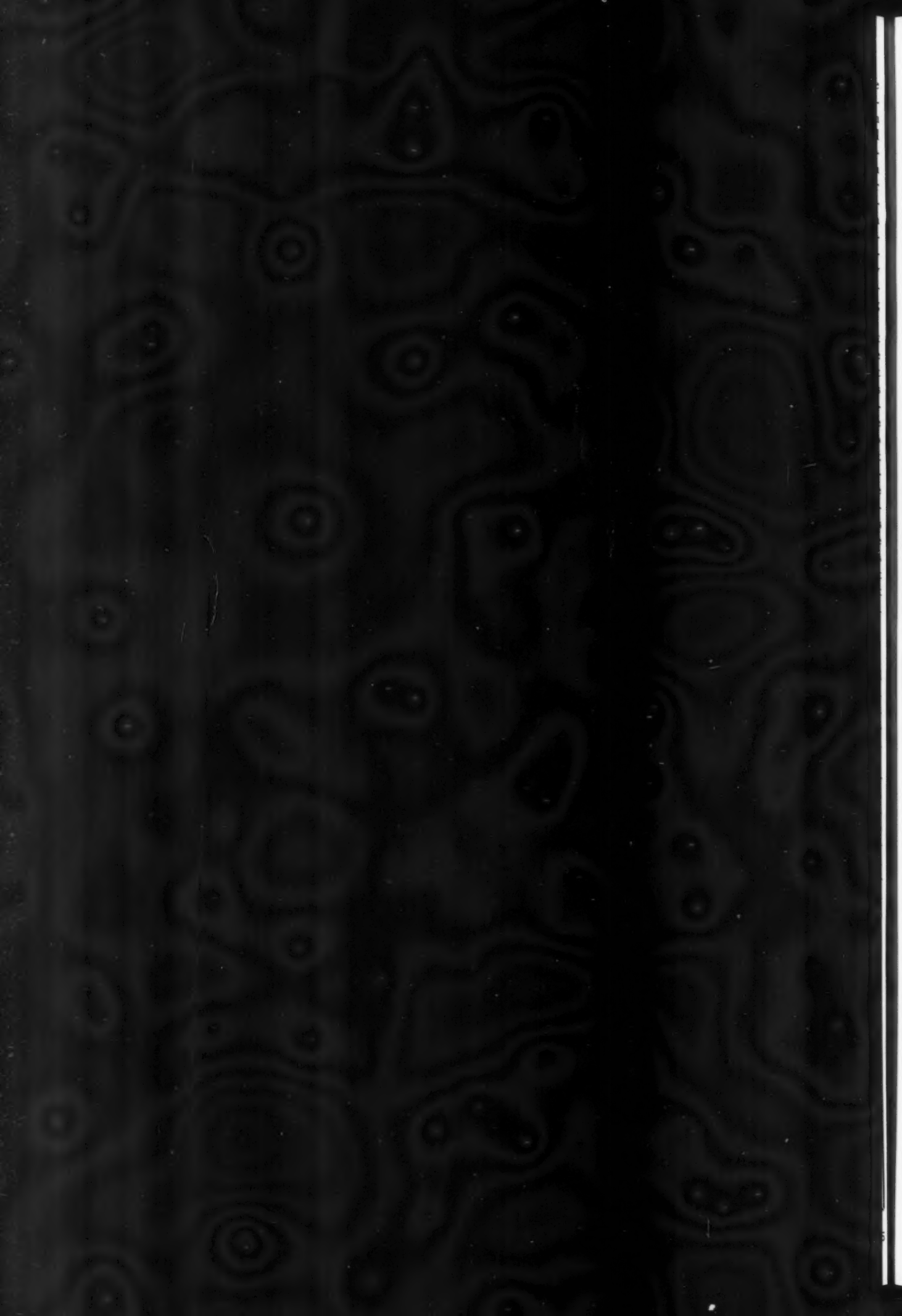
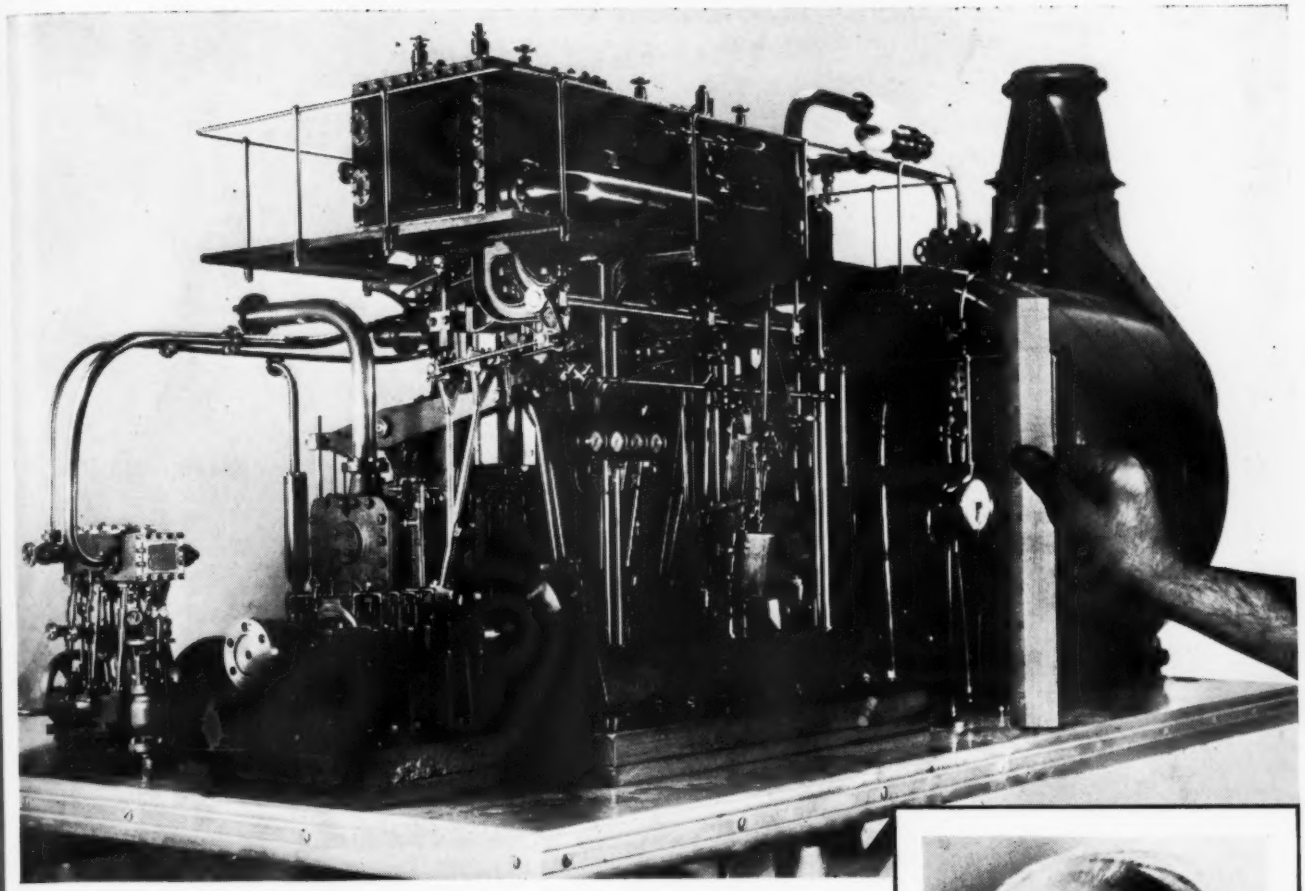


Table II—Time of Ortho-Tolidine Contact

		Chlorine content *Instantaneous ppm*	*5 min ppm*
Ahead of control flash point	(A)	0.00	1.00
Ahead of control flash point	(B)	0.15	0.40
At control flash point	(C)	0.85	1.00
Beyond control flash point	(D)	2.60	2.80





Representing 20 years of spare-time work, the complete plant stands 22 in. high

These Models Are Masterworks

▶SEVERAL YEARS AGO I went out to 1928 Cordova St, Los Angeles, Calif., to visit Fred D Hood and inspect his working scale models of steam engines and boilers. I had seen some fine machine models in my day, but nothing to approach these in perfection of detail. They truly reflected their builder—a gentleman in the best sense of the word, an engineer, a teacher, a craftsman of superlative skill and amazing patience.

Today the monumental job is substantially finished. The pictures and captions here and on page 98, briefly tell the story to date. Fred Hood began building his miniature triple-expansion marine engine in 1924, finishing it ten years later. Then he started work on the 12-in. diameter Scotch marine boiler, which took him another six years. Most of this was spare-time work for Mr Hood was busy teaching until 1940 and could devote only a few hours evenings to modeling. The boiler feed pump and circulating engine were started in 1942 and finished in 1944.

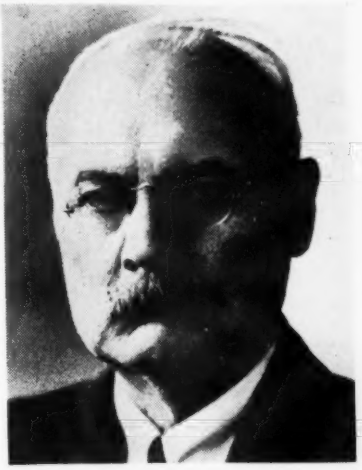
This complete power plant—20 years of work, stands 22 in. high, 17 in. wide and 3 ft., 7 in. long Figured on any reasonable basis, these models are worth many thousands of dollars. Every part is machined to scale—a complete working unit down to the smallest detail—no fakes or dummy parts.

The steam gages are good examples of Fred Hood's amazing patience and meticulous attention to detail. Connecting tubes are 0.06 in. OD. The union nuts are tapped No. 2-56 machine-screw thread. Ends of the plug cocks are threaded 0-80 and the small ends of the plugs are $\frac{1}{16}$ in. The gage hands are watch second hands (the only ready bought parts on the entire job).

The accompanying photographs fail to do justice to Fred Hood's work, but the engine close-up on page 98 will give some idea of the detail. Note the $\frac{7}{16}$ in. silver dials on the gages stamped with $\frac{1}{32}$-in. letters, gage tubing about $\frac{1}{16}$-in. diameter, No. 0.80-thread nuts on the links of the main valve gear, the visible $\frac{3}{4}$-in. piston rod and the 1¼-in. crankthrows.

PHIL SWAIN, *Editor*

(*Additional model facts and figures on page* 98)

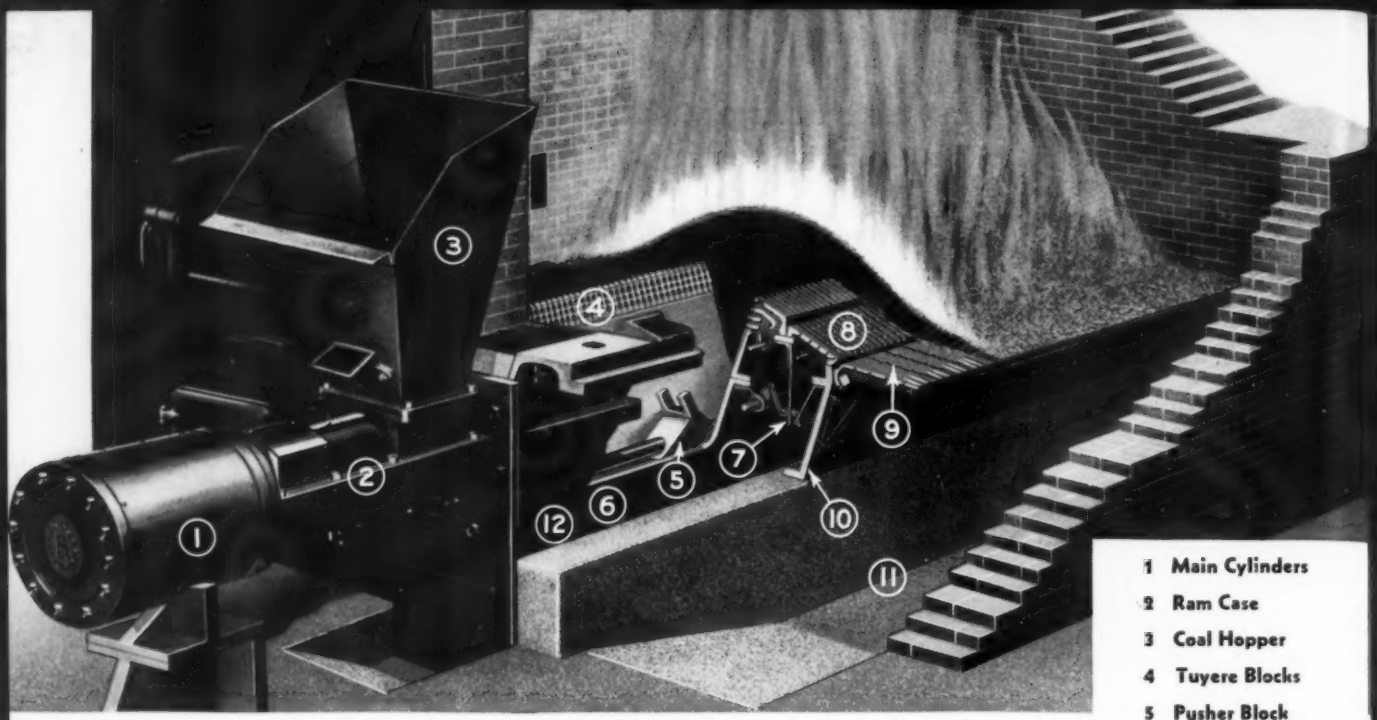


Fred Hood—the Builder

Born in 1867, Fred Hood served his marine-engine-building apprenticeship in England, became U. S. citizen, worked here as machinist, steam engineer, factory foreman, draftsman, installer and inspector of ship's machinery.

Also he made the rounds of educational institutions—a year of pharmacy study in St. Louis, a literary degree from Woodstock College (Ontario), a Stanford degree in mechanical engineering.

From 1906 to 1939 Fred Hood was head of mechanic arts at Los Angeles Polytechnic High School. Then he retired from official life but not from model making.



How the Riley Side Dump Stoker Operates

Coal is fed into furnace beneath the fire by coal ram and is evenly distributed by pusher blocks. Action of ram and pusher blocks keeps the fuel bed porous and open assuring intimate mixing of air and coal. The volatile gases are driven off over the retort and are ignited as they pass through the incandescent fuel bed. Air is admitted through tuyeres at the top of the retort. Combustion of the coal is completed over the sloping combustion grates and dump plates. Smokeless and efficient combustion results.

REDUCE COAL BILLS

Because of their efficient operation, Riley Side Dump Stokers reduce coal bills not only by burning less coal but because of their ability to burn low priced coals.

"We have been able to reduce our coal bill 33⅓%."
—Brown Shoe Co., Moberly, Mo.

SAVES LABOR

Due to its automatic and mechanical action, labor is saved and labor turnover reduced.

"We were having trouble in keeping firemen. The stokers made the firemen's task so much easier that we have no labor difficulties now."
—Lewis Manufacturing Co., Walpole, Mass.

BURNS CHEAPER COAL

Not only do fuel savings result from being able to burn cheaper coals but in time of emergencies, you can maintain your steam load with poor grades of coal.

"With this type of stoker you are able to use a much cheaper grade of coal."
—Palace Laundry Co., Niagara Falls, N. Y.

INCREASES CAPACITY

Because of their ability to efficiently and completely burn greater quantities of coal, steam capacity of boilers is increased.

"We are able to carry the entire peak load with one boiler, whereas two boilers were always required when firing by hand."
—Mishawaka, Ind., Water & Electric Plant

ELIMINATES SMOKE

The use of the underfeed principle of combustion and the proper application of the stoker with reference to boiler eliminates smoke.

"We have no trouble with smoke while with hand firing we were always in bad with the smoke inspector."
—Y.W.C.A., Indianapolis, Ind.

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Because coal feed and air supply are automatically regulated, uniform steam pressure is maintained.

"We are able also to carry an even steam pressure while our load is very much fluctuating."
—United Dairy Co., Wheeling, W. Va.

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The Design Characteristics of Riley Side Dump Stokers assure . . .

Complete Reliability and Dependability

A stoker is subjected to severe service. The construction of Riley Side Dump Stokers is rugged, massive and simple throughout. This strength and ruggedness assures long, continuous trouble-free service. After years of operation, you will obtain the same satisfactory performance as when the installation was made. Sound business judgment dictates the selection of a well designed and heavily constructed stoker.

High Efficiency and Large Savings

High efficiency depends upon the intimate contact of air under the proper pressure with the coal. The quick thrust of the Riley coal plunger and the effective breaking action of the distinctive pusher blocks provide a porous, uniform fuel bed. Division of the air chamber into separate zones of pressure assures properly distributed air at the desired pressure. These features assure high efficiency and large fuel savings.

Low Maintenance and Trouble-free Operation

The rugged, simple construction of Riley Side Dump Stokers assures low maintenance. All furnace parts subjected to heat are manufactured in small sections and designed to be effectively cooled by the air passing through them. Adequate cooling of furnace parts must be provided if low maintenance is to be obtained. The only moving parts in the furnace are the pusher rod and blocks located in the bottom of the retort. No moving parts are used in the hot zones where they would be subjected to heat with unavoidable high maintenance. The absence of moving parts in the fire also reduces siftings to a minimum, practically eliminating this nuisance and fuel loss.

A Riley engineer will gladly call at your request to advise what Riley Side Dump Stokers can do for you, without cost or obligation in any way. At least write for the new Riley Side Dump Stoker Catalog.

Eight Riley Side Dump Stokers firing 200 H. P. Boilers

A Few of the Well Known Users of Riley Side Dump Stokers

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Royal Typewriter Co.
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efore purchasing Boiler or Fuel Burning Equipment

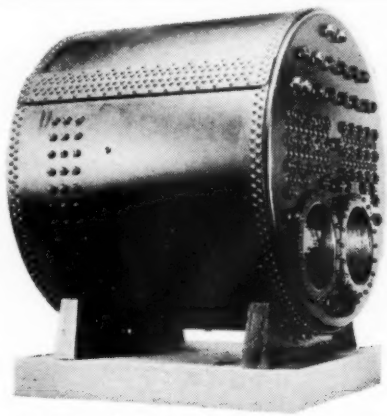
Model Facts and Figures

TRIPLE-EXPANSION MARINE ENGINE runs condensing on 125-psi steam. Stroke 2½ in. Bores 1$\frac{13}{16}$, 2¼ and 3$\frac{31}{32}$ in. H-p and i-p stainless piston valves and 1-p flat valve are bronze faced. Piston rods are $\frac{21}{32}$ in., valve rods $\frac{7}{32}$ in. and crankshaft ¾ in. Condenser has 70 ft of ⅛-in. brass tubing. Engine contains about 1700 nuts, bolts, studs, cap screws and machine screws, and 56 valves and cocks. Smallest thread is No. 0-80. Complete power plant, hooked up with water in boiler, weighs about 500 lb, stands 3 ft, 7 in. long, 17 in. wide and 22 in. high. At 150 rpm and 29.24 mep, theoretical ihp is 0.57.

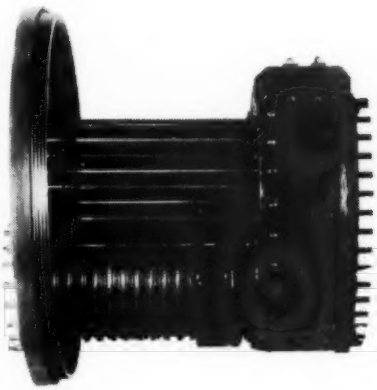
THE SCOTCH MARINE BOILER, 12 in. dia x 12 in. long, 7½ sq ft heating surface, has a shell of ⅜-in.-thick stream pipe, 23 through staybolts (¼-in. root) and 175 ($\frac{5}{32}$-in.) combustion chamber stays, 106 shelby tubes, $\frac{1}{16}$ in. OD. Two 3-in. corrugated furnaces are fired by natural gas.

COMPOUND CIRCULATING PUMP ENGINE is ½ x 1 x ⅝ in. stroke, condensing. H-p piston valve is ¼ in., crankshaft ¼ in., piston rods ⅛ in., valve rods $\frac{3}{32}$ in.

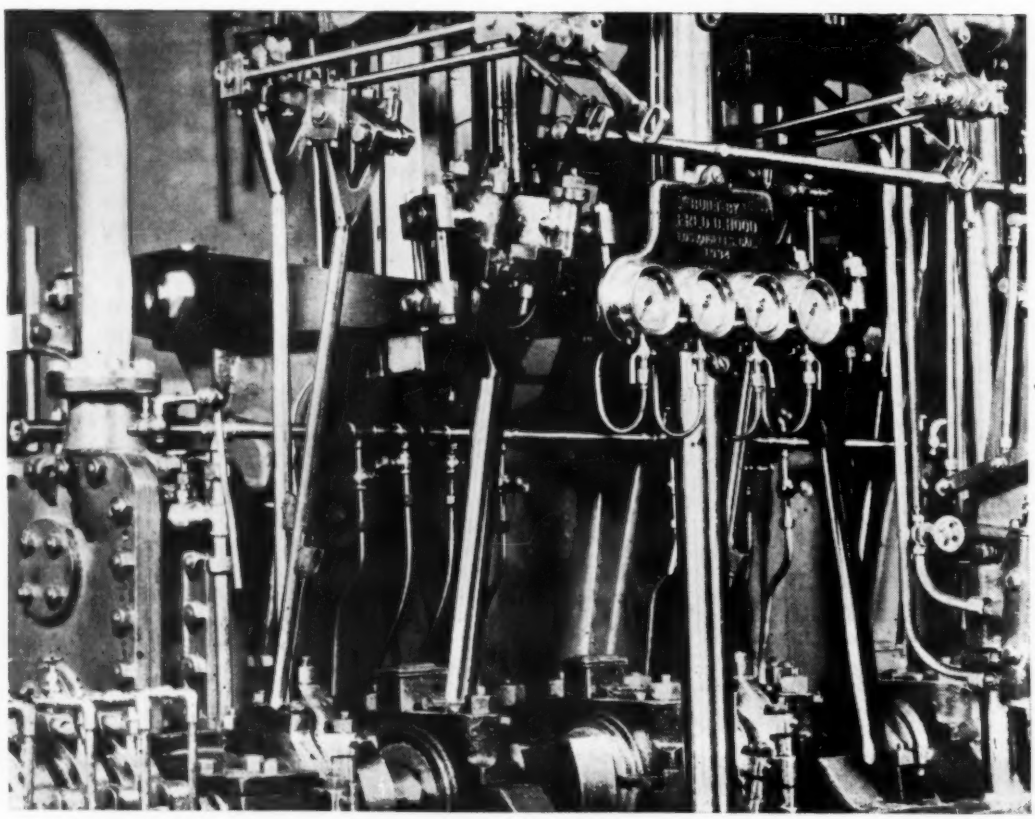
BOILER FEED PUMP had two h-p condensing cylinders, ½-in. bore x ⅝-in. stroke, with Scotch yoke connection. Water ends are double acting, ⅜ in. dia.



Scotch marine boiler, six years in construction, is 12 in. in diameter, 12 in. long



Inside parts of Scotch marine boiler. At left note the thread for attaching head



This engine closeup is about half actual size. Thus the sterling silver gage dials have an actual diameter of 7/16 in. The gage tubing is less than 1/16-in. OD and the gage hands are watch second hands

STEADY JOBS *and* EQUIPMENT BUYING

SUSTAINED employment is not an attainable goal unless we can moderate the erratic fluctuations which have characterized the markets r producers' equipment in past periods.

In the 35th editorial of this series, "Sustained onstruction Activity", it was pointed out that there no specific that can cure our economy of its oom-or-bust" proclivities. Rejecting the notion at the construction industry could be so managed to stabilize business as a whole, that editorial ressed the important contribution it could make that end, and suggested several practical expeents through which construction activity might be gularized.

Producers' equipment represents an area of proction quite as broad and diverse as construction, ough smaller in aggregate value. The classification mbraces all types of durable equipment bought and ed for profit—locomotives, motor trucks, electric nerators, conveyors, machine tools, farm impleents, and so on down to surgical instruments and ntists' drills.

Although the output of such equipment averages er a long period only 5 or 6 per cent of the nation's tal output, it resembles construction in its extraordinary ups and downs. While its component items ffer widely in the amplitude and violence of their ctuations, the class as a whole is one of the most nstable sectors of the economy, making therefore a ite disproportionate contribution to the cyclical wings of total production and employment. From 29 to 1932, for example, the decline in the output producers' equipment (at constant prices) was 5-70 per cent, in contrast to a decline of 25-30 r cent in the national output exclusive of such quipment and construction.

A more recent example of the volatility of demand this field may be found in the movement of a onthly index of orders for industrial equipment, hich rose from 92 in the spring of 1936 to 160 in the ring of 1937, falling thence to 65 in the summer 1938 and rising again to 142 in the fall of 1939. uch fantastic oscillations present an obvious and escapable challenge to all concerned with ecomic stabilization.

Not only are these fluctuations bad for the econny; they represent demonstrably bad buying policy the part of the purchasers of equipment. Peaks demand come characteristically just before a busiss depression (1919, 1929, and 1937, for example) when machinery costs the most to buy and install and when it has the lowest expectancy of continuous use. At exactly the wrong moment everyone wants to buy. In the depression itself, on the other hand, with costs down, and with nowhere for the economy to go but up, equipment is a drug on the market. No one wants it when it is cheap and has the greatest prospect for steady employment. Here is a behavior pattern so profoundly irrational there must be hope for its correction.

There is an inveterate tendency for business management to forecast the future simply by projecting the trends of immediate past. Although it is axiomatic that the chance for an extended period of further prosperity is inversely related to the duration of the prosperity already experienced, this truism is generally ignored. The longer the boom has run, the more certain is business management that it will continue indefinitely. Convinced at last by "actual experience" that prosperity is here to stay, executives give the green light to commitments for expansion and modernization previously deferred in a skeptical attitude of "wait and see". The result, so often repeated in our economic history, is an explosive burst of demand for equipment coincident with, and contributing to, the final spasm of a boom. Witness the phenomenal rise in industrial equipment orders during 1928 and the spring of 1929.

The same prophetic illusion works in reverse during a depression. Recent experience is projected into the future. Although the mathematical probability of an imminent and prolonged period of prosperity increases directly with the duration of a depression, it finds little reflection in business decisions. Timidity and caution are the order of the day.

Compounding the errors caused by faulty perspective, are a number of influences which make it extremely difficult for individual enterprises to follow a policy geared to sensible long-term considerations. In a boom, particularly in its climactic phase, most producers find their order books crowded beyond the potential of their current capacities and are faced with the alternatives of expanding or losing trade to competitors. In depression the situation is reversed, and producers with unused facilities find it difficult to justify increases in their capital charges.

An even more controlling factor in many cases is the availability of funds. This is especially important

for small concerns. Typically such firms enjoy but limited credit, and with no ready access to the securities markets, their capital expenditures depend primarily on earnings. When they are making money, they can afford to buy equipment; when they are losing, they largely disappear from the equipment market. Even great enterprises, though less dependent on earnings as a source of capital financing, are profoundly influenced by the volume of internal funds available for the purpose, a volume as a rule far greater in prosperity than in depression. Moreover, it is usually easier in good times to obtain outside funds through the sale of stock or by borrowing, since in bad times bankers, underwriters, and investors are susceptible to the same timidity and caution that afflict business management generally.

We are dealing here with a combination of psychological, physical, and financial forces which conspire to aggravate the instability of demand for capital equipment. What can be done to reduce this instability and thus to bring equipment purchasing into a more sensible and constructive pattern?

There is no panacea, no royal road to the solution. The problem has been with us since the beginning of the industrial economy. It is complex and difficult. It is not, however, wholly intractable. We may reasonably hope that industry will, through intelligent effort, make substantial progress toward a satisfactory solution. The industrial equipment field is one in which government, except for war periods, has exerted little direct control. The best insurance against the institution of government measures is to so conduct activities in the equipment field that no justification for government interposition can be made.

☆ ☆ ☆

1. The first and most important step is for industry itself to reconsider its heretofore haphazard and opportunistic policy in the purchase of equipment, substituting so far as possible a regularized, long-range programming of expenditure that will resist both the excited long-buying of booms and the equally disturbing underbuying of depressions. Such long-range programming is particularly appropriate and advantageous for large enterprises in established industries such as railroads, electric power, steel, automobiles, and the like, but it makes sense much more generally.

Once executives come to realize that a reasonably stable equipment program contributes not only to the welfare of the economy but also to the lowering of their long-run equipment costs, the opportunity to combine a public service with private advantage should induce them to recast their policies accordingly.

There is an even more compelling reason for purchasers of industrial equipment to do everything possible to regularize their demands. Some concerns unquestionably will find themselves in a postwar position where speedy delivery of needed equipment, even though it involves the payment of premium prices, will seem to be justified. But there is no system of accounting that can show it to be a profitable transaction to promote an equipment industry boom that runs a brief course only to collapse when the backlog of deferr maintenance and development has been satisfied. Tha historically, has been the trigger which trips the do to the depression phase of the business cycle. No imm diate advantage can compensate for the contagio paralysis that infects all business enterprise wh major layoffs occur in any major segment. No pr cautionary measures, self-imposed by business, can regarded as unduly severe if they can prevent th devastating blight.

2. Financial agencies can and should play a respo sible role in regularizing equipment demand. Fun for the purchase of producers' equipment should offered boldly and at low interest during depressi periods, and should progressively tighten as a boo market bids up the price of purchase and installati Banks and financial houses have excellent facilities f gathering and interpreting market and general ec nomic information. It is good business for them, a for the national economy, to exercise their accept discretions in a manner that will help to promo economic stability.

3. There now is almost universal recognition of t need for a thorough-going revision of our corporate t structure to the end that effective incentives may offered for private capital investment. The possibili of including provisions which would offer special t concessions to equipment investments made in depre sion periods is worthy of intensive exploration.

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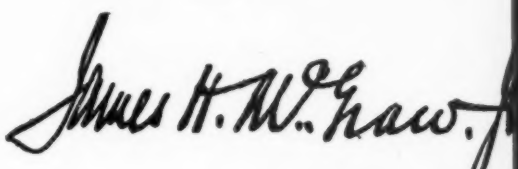
The fundamental problem here is educational. all business enterprises in a position to do so we to regularize their equipment expenditures, it wou have a tremendously beneficial effect. True, it wou accomplish no miracles. For many concerns it is n feasible to schedule equipment buying over a lo period. Even those who do schedule it are likely practice to attain only a relative stability. It must acknowledged, moreover, that few programs cou withstand indefinitely a very deep and prolong depression such as we had in the thirties. Neve theless the adoption of stabilization policies wh feasible would make a signal contribution both the restraint of booms and to the mitigation of d pressions. Here is something industry can do itself.

It is easy to disparage such remedies for econom instability as are here proposed on the ground th they are partial only. However, joined with oth also partial, they can achieve in combination a so progress toward the goal of sustained high level e ployment—progress that is unattainable through ec nomic cure-alls. The road suggested is a slow ro and difficult, but it leads upward.



President, McGraw-Hill Publishing Co., I

Proximate Analysis and Heat Value With Home-Built Apparatus

K M White, of Tacoma, Wash., explains construction details of coal bomb calorimeter, laboratory ball-mill grinder, and drying oven. This testing equipment is surprisingly accurate

▶PROXIMATE ANALYSIS of coal usually includes heat value, moisture, volatile, fixed carbon, ash and sulphur. The laboratory equipment we rigged up determines all of these except sulphur. Our homemade apparatus has proved surprisingly accurate. It is used not only for coal analysis, but also to test ash samples for combustible percentage. This helps us cut down loss of fuel to ashpit. We are also able to control the moisture used to temper the coal.

The table compares our results n heat value with those reported by disinterested chemists.

Our calorimeter works on the customary principle. The finely divided coal sample in the bomb is mixed with hydrogen peroxide (to supply oxygen) and is ignited by the electrical fusion of a fine wire. The resulting complete combustion of the sample heats the bomb, the surrounding water, and the container of the water. The heat value of the fuel is figured from the weight of sample, the temperature rise of bomb and surrounding water, and the heat capacity of bomb, water and can per degree temperature rise. A rotating stirrer insures uniform temperature throughout the water.

We built the calorimeter case, Fig. 1, of ¼-in. plywood, using double walls to reduce radiation loss. A local tinsmith made the copper can large enough to carry the bomb and the water used in the test—two liters. One liter is 1,000 cubic centimeters, (or 2.20 lb of water at 62 F.) The water deflector, which also holds the bronze pivot on which the bomb rotates within the water can, was made of sheet copper.

In the bomb assembly, Fig. 2, note that the fusion cup and its cap are turned from stainless steel. To keep the

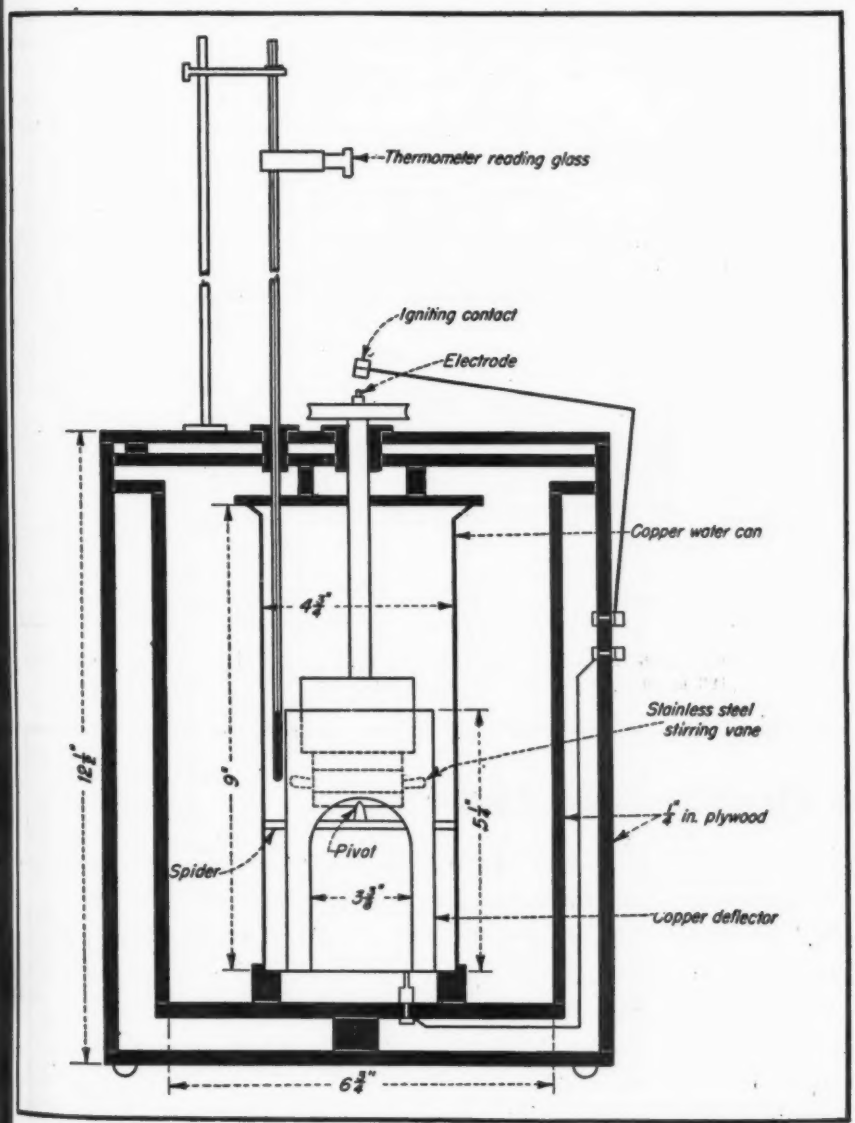


Fig. 1—The calorimeter: Inside the double-walled plywood case is the copper water can containing rotating bomb. Wiring shown fuses wire within coal sample

Comparison of Btu Tests

Chemists' test	*Our test*	*Btu diff*	*Per-cent*
10,500	10,454	−46	− .44
10,727	10,758	+31	+ .29
6467*	6540	+73	+1.1
10,436	10,337	−99	− .95
10,735	10,361	−374	−3.6
10,276	10,301	+25	+0.2
10,171	10,178	+7	+0.07
10,687	10,372	−315	−3.0
10,959	10,552	−407	−3.8
10,420	10,293	−127	−1.2
10,242	10,178	−64	−0.6
10,047	10,173	+127	+1.2
10,189	10,186	−3	0.00
11,121	10,933	−188	−1.7

* Lignite

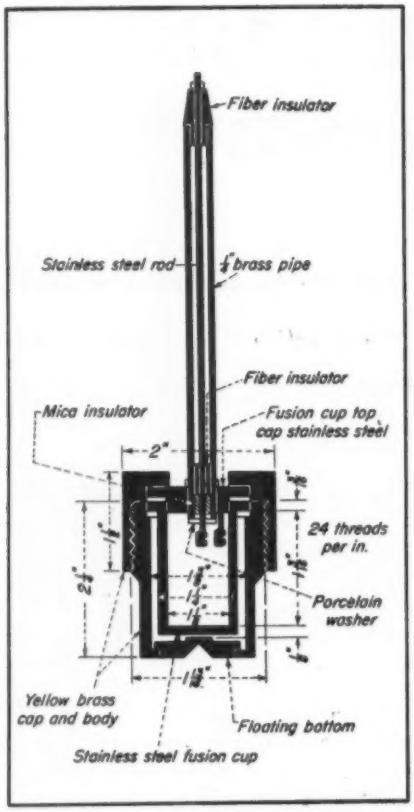


Fig. 2—Construction of the coal bomb

water equivalent of the calorimeter as low as possible, yellow brass (which has a low specific heat) was used for the outer case and the screw-down cover. Because brass stock of the right size was not available we cast the case from melted scrap.

The projecting part of the fusion cap cover that goes down into the cup must be a close fit to avoid gasket blowouts when the coal charge is ignited.

Electrodes on the cover are made of stainless-steel rod. A piece of ¼ in. brass pipe carries the center electrode, which is insulated from the brass tube and cup cap by mica insulator, porcelain washer and fiber insulator, shown in Fig. 2. The fiber cap is tapered to hold the driving pulley.

A variable resistance in the ignition circuit is adjusted (with the cap off) so that the fuse wire comes quickly to incandescence and melts in about two seconds after the circuit is closed. The fuse wire is obtainable from chemical supply companies. The stirring vanes are of sheet stainless steel. Specially made wrenches to lock the bomb and cover must be sturdy as the loaded bomb has to be made up tightly. During tests the motor drives the calorimeter at about 150 rpm through a loose belt made of heavy cord. A loose drive is important in order to reduce the heat input.

To grind the sample we run it first through an old-style coffee mill, then through the ball mill, in Fig. 3, to reduce it to 100 mesh. We turned the body of the ball mill from a piece of 4-in. extra-heavy pipe. Ends are ¼-in. iron plate. Balls are of steel from various sizes of ball bearings, and range from ⅜ to 1 in.

When this mill is three-fifths full of balls, and turning at about 60 rpm, with enough coal to fill the spaces between the balls, it takes about 45 min to grind the sample to 100 mesh.

We built the drying oven of hard-pressed asbestos. It is heated by an electric resistance element at the bottom and regulated by a range thermostat adjusted to give as low a temperature differential as possible. A pilot light, which is located in the circuit, shows when current is on.

We made a muffle of cast refractory, winding a 1000-watt electric element around it. This was covered with hard-drying fireclay and then with high-temperature insulation. Regulation is manual.

It was necessary to buy such apparatus as the desiccator, balance and thermometer. We chose a standard bomb-calorimeter thermometer because this type gave us the highest accuracy at the lowest cost. Ours has a range of 18 C to 28 C and is subdivided into 100 deg. A student-grade chemical balance was accurate enough for our control work.

We do not determine sulphur, but use an average for the type of fuel we are testing.

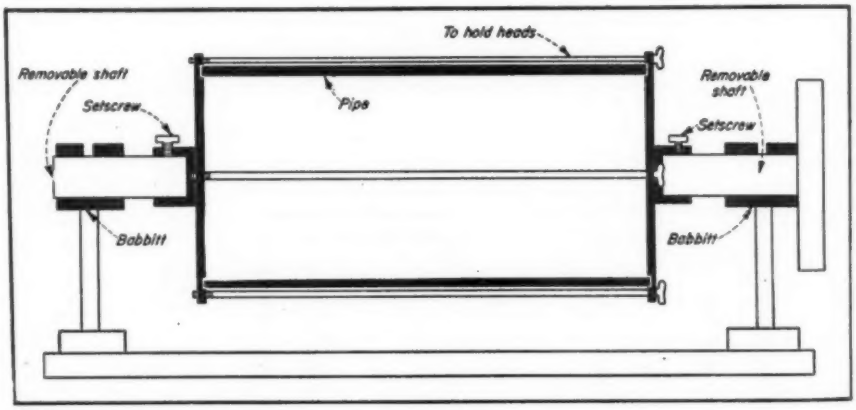


Fig. 3—Ball mill made from pipe, and filled with bearing balls, completes reduction of sample to 100 mesh after preliminary grinding in old-style coffee mill

Are You Planning to Do Your Part?

Paper is a No. 1 war-material shortage because over 700,000 different war items are wrapped, packaged, labelled, tagged or made from paper or container board. The Pacific war will require stupendous amounts of paper and board since double and triple packing are required for protection against weather, insects, and other hazards on the fighting front.

So please: (1) Share this magazine with your associates. Because of the paper shortage, the number of copies is limited. (2) Organize for a continuous drive in your office and plant to collect waste paper of any kind to put into paper salvage. Clean out old files, dead correspondence, obsolete records, useless display materials, cartons that are not likely to be needed, etc.

How the Gas Turbine Will Fly

Military needs for fast pursuit planes have resulted in greater development of jet-propulsion units than geared drives or units for power and ship propulsion. Future power machinery will gain from research in aviation gas turbines

By C D FLAGLE and F W GODSEY
Westinghouse Electric Corp

▶AVIATION PROGRESS has depended from the first on development of more powerful engines suited to bigger and faster airplanes. In the future, jet propulsion (by gas turbine) and gas-turbine-propeller drives will result in new design concepts for low-drag airframes for high-powered planes and for high-speed flight.

The modern reciprocating aircraft engine is one of the great technical achievements of our age, inspired to no small degree by military requirements. However, power ratings have reached a point where further major increases can be obtained only by improvements in fuels or addition of cylinders. The gas turbine lends itself readily to increased power ratings and, when geared to a propeller, its usefulness extends to all aircraft requiring engines of greater than perhaps 1000 to 2000 hp and designed for all speeds up to and in excess of 500 mph.

Jet Propulsion

Jet propulsion of aircraft has recently become a subject of much publicity and confusion. Principal advantages of the jet engine, a gas turbine, are its simplicity and light weight. Little oil for lubrication is required and no water or air cooling is needed. The jet engine's thrust is relatively constant over normal airplane speed ranges and rating is usually given in lb of thrust rather than hp. A thrust of one lb at 375 mph is equivalent to one hp. At this speed the *apparent* efficiency of the jet engine is less than half that of the conventional reciprocating engine. Its take-off thrust is about one quarter that of a propeller with the same rating at 375 mph. Thus jet propulsion gives excellent high-speed performance at the expense of range and low-speed characteristics.

For commercial aviation, the gas turbine geared to a propeller offers attractive possibilities. The power plant can be much lighter than that of a reciprocating engine, less than three quarters of the weight. The gas turbine operates on four to eight times the quantity of air of the reciprocating engine so that about 20% of the useful power can be used as "jet propulsion" efficiently.

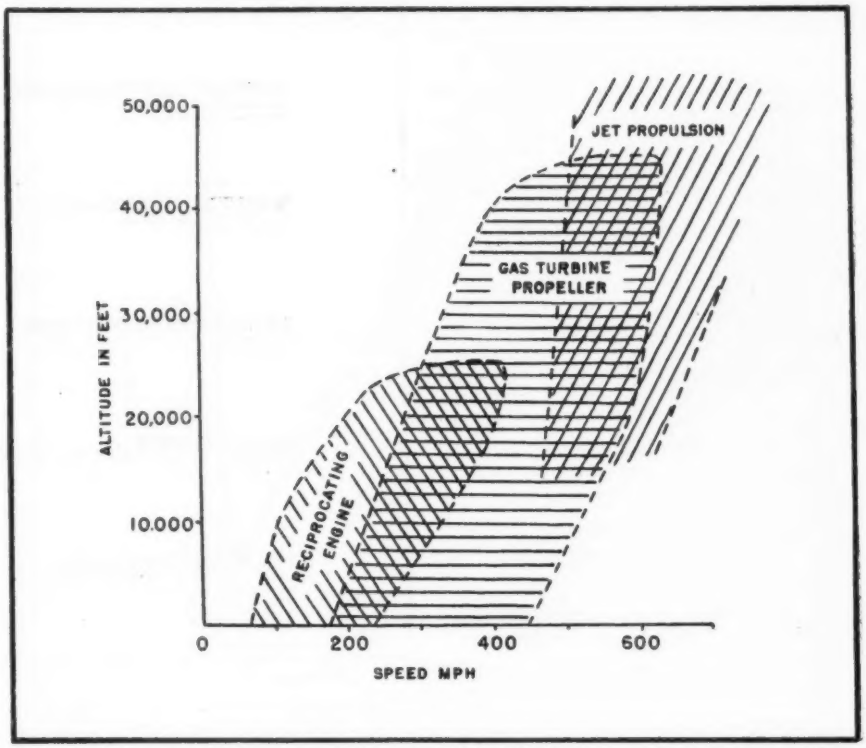


Fig. 1—Jet is preeminent in high-speed high-altitude range, but the gas-turbine-propeller arrangement is better adapted to commercial and transport flying

The reciprocating engine presents a dismayingly large frontal area when placed in a wing nacelle. Total profile area of power plant frequently exceeds that of the fuselage. Also, large volumes of cooling air must be forced around the cylinders or through radiators, accessories and oil coolers. Gas-turbine plants, whether jet propulsion or geared-propeller, permit designs of less drag.

A simple open-cycle gas turbine can be built today to work at 1500 F but metallurgical progress offers prospect of higher temperature. At 1500 F with a compression ratio of 10 to 1 and compressor and turbine efficiencies of 85%, a fuel efficiency of 26% can be achieved. By increasing compressor efficiency to 87% and turbine efficiency to 89%, a thermal efficiency of 28% at sea level is possible. At 15,000 ft altitude, however, because of low ambient temperatures, the cycle efficiency rises to 31%.

The efficiency of a gas turbine is highest at its rated load and rated rpm. As rpm decreases efficiencies of compression and expansion drop off and compression ratio decreases rapidly. Since useful power output of the machine is the relatively small difference between power developed by the turbine and power absorbed by the compressor, any change in compressor or turbine efficiency is magnified in its effect on power output. Turbine output is hardly sufficient to drive the compressor, much less supply power to the propeller, at much below half speed. Idling speed for a gas-turbine-propeller drive is between half and one third rated rpm.

General characteristics of jet propulsion, gas-turbine-propeller drive and reciprocating engines are shown in Fig. 4. It is interesting to note that the gas-

turbine-propeller airplane is superior to conventional aircraft on every count with the exception of altitude ceiling, where they are equal if the reciprocating engine is supercharged.

Since turbine-propeller fuel economy and installed power-plant weights are both superior to those of the conventional engine, the long-range and short-range carrying abilities of the turbine-propeller aircraft are superior to those of conventional design. On the other hand the jet-propelled aircraft has a very light power-plant installation and can get off the ground for short flights with about five tons more payload (for the planes under comparison) than the conventional aircraft and about three tons more than the propeller version. However, jet propulsion requires so much more fuel than other types that, at about 2000 miles, the jet plane loses out to the reciprocating engine and is far behind in payload carrying ability.

As with the jet-propelled fighter, the jet bomber or cargo plane must be limited in use to relatively short range, very high speed, high altitude operations which can stand the expense of high fuel costs, until more has been learned about the aerodynamics of flight at speeds over 500 mph. The gas turbine with geared propeller, however, has immediate applications in all classes of service where requirements are much above 1000 hp at usual flight altitudes and should be ready for use when aircraft designs require 10,000 hp or more in a single power-plant unit.

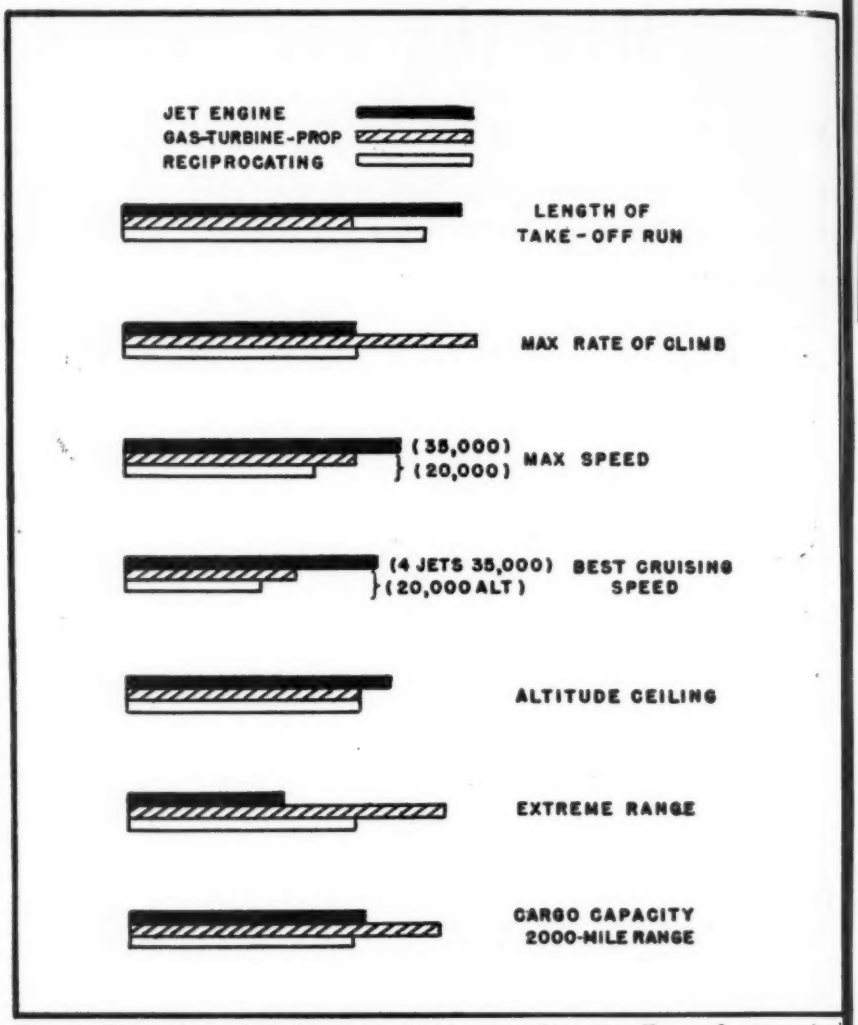


Fig. 4—Comparison of performance of jet, gas-turbine-propeller and conventional reciprocating gasoline engines for cargo and passenger planes of tomorrow

COMPARISON OF GAS TURBINES FOR JET PROPULSION AND GEARED PROPELLER

Fig. 2—Axial-flow jet engine (gas turbine) is naturally suited to installation in long small-diameter nacelle which presents less frontal resistance

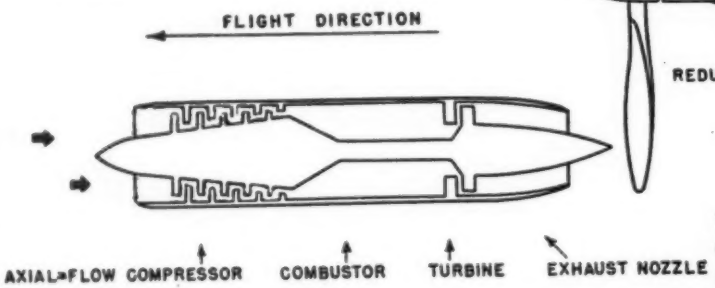
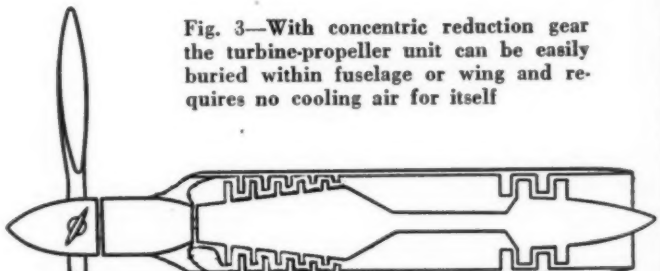
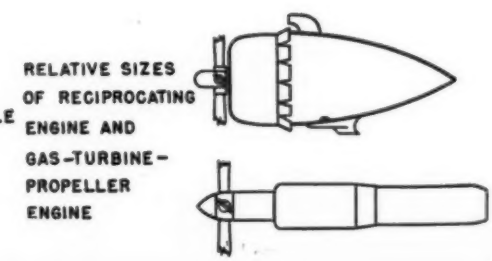


Fig. 3—With concentric reduction gear the turbine-propeller unit can be easily buried within fuselage or wing and requires no cooling air for itself





THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

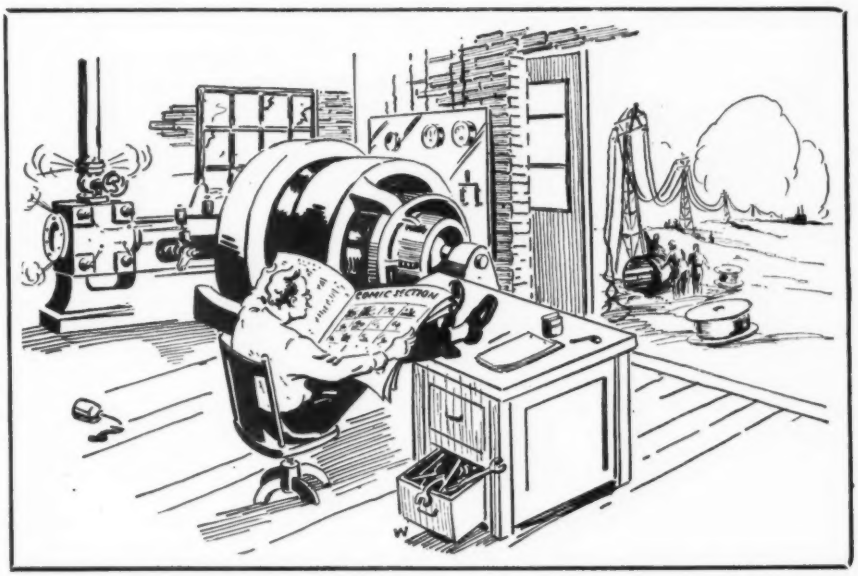
What Goes With the Title "Chief Engineer"?

Answer: Knowing his plant's possibilities and how to keep costs down are "musts." Being industrious enough to keep machinery in repair is important, too. To these requirements William Meinecke adds presenting acceptable plans to management

DURING THE LAST TWENTY YEARS I have seen many individual plants go over to purchased power. In 75% of the cases an incompetent chief engineer was to blame. Instead of setting up an efficient maintenance program to catch little troubles before they become serious many engineers operate their plants on a hit-or-miss basis. Also, when asking for money to make necessary repairs many neglect to explain and prove to management that they are investing the company's money, rather than just spending it without getting an adequate return. Therefore, few business executives understand the power problems in their plants.

One industrial plant, built about 25 years ago, contained the best equipment obtainable at that time. Naturally while new, things operated pretty smoothly, but a few years ago it was run down by incompetent operation and maintenance; because cost of power was more than two cents a kwhr, management was considering a change to purchased power. While the public utility was estimating the job, the chief engineer of the plant died.

A new chief at once saw the possibilities of improving the plant. After making a survey he put a written proposal before the management whereby with a minimum expenditure he could put the plant in condition to generate its own power cheaper than at the purchased rate. Accordingly, plans for purchasing power were put aside, the necessary money was appropriated and within one year boilers were rebaffled, firing method changed, engines overhauled and steam lines re-routed and properly trapped. An efficient maintenance system was set up whereby little troubles were rectified before they turned into shut downs. Power cost dropped from two cents to nine mills per kwhr. Needless to say, this improvement sold management the idea of retaining its own power plant—all the work of a capable chief engineer.



In another instance I took charge of a small ice-cream factory. The plant consisted of two 15-ton vertical ammonia compressors, a 10-ton ice freezing tank, and an ice-cream storage room. When I first talked to the manager he said that they bought an additional two tons of ice a day because they could not make enough themselves. Both compressors ran 24 hr a day, yet considerable spoilage resulted from frequent

shutdowns. After a survey I took the job with the understanding that I would have a free hand with a reasonable amount of money to put the plant in good condition. I guaranteed that the money spent would be returned in less than one year.

Things that needed immediate attention were: (1) Two hundred ft of 2½-in. suction lines were either bare or covered with only a thin layer of hair felt. (2) Ice tank was only partly covered. (3) Brine agitating-pump impeller was partly corroded away. (4) Condensers were in bad shape, consequently they operated at high head pressure and wasted power. First job was to cover all suction lines with cork, and to cover the ice tank with sheet cork and incase it in wood. I drained the tank, cleaned the coils thoroughly, checked them for leaks, and put a new impeller on the brine agitating pump. After overhauling both compressors I installed a bank of new condensers.

We no longer needed to buy ice and instead of running two compressors 24 hr a day, one carried the load most of the time; costly shutdowns disappeared and lower freezing temperatures produced a finer texture of ice cream. Cost of the improvements was returned to the company in less than a year.

Management must take active interest in power production and exercise care to select a competent chief engineer. No individual has the right to that position unless he has the knowledge and ability to operate a plant efficiently and keep it in repair. He should also be able to present proposals to management in a clear, concise and able manner.

Quick Way to Make Bushings

Metal spraying has long reclaimed worn shafts and bushings large enough to spray internally. Because small bushings can be constructed entirely of sprayed metal, wall thickness determines their resistance to crushing when pressed into place*

BUSHINGS AND LINERS made entirely of sprayed metal have the same oil-retaining and load-carrying qualities as metal-sprayed journals. Another advantage is that any combination of metals procurable in wire form can be used. For instance: A thin layer of babbitt for the bearing surface can be backed up with bronze, aluminum or steel to form the major volume of the bushing. There is no danger of the two metals separating in service. Usual procedure for bushings is to spray the metal directly on a pipe mandrel (see "How to" article on page 122) and then bore away the pipe metal.

In Fig. 1, bearing *A* is made of a 0.020-in. layer of babbitt backed with ⅛ in. of aluminum; *B* is plain bronze ⅛ in. thick; *C* is 0.020 in. of babbitt backed with ⅛ in. of 18-8 stainless steel; *D* is 0.020 in. of babbitt backed with ⅛ in. of bronze; and *E* is 0.020 in. of bronze backed with ⅛ in. of aluminum. All have a ⅛-in. flange.

Tests conducted by H Shaw, consulting and research engineer of England, show that a sprayed babbitt bearing has a much lower coefficient of friction than one of cast metal. Most remarkable reduction in friction occurs at a speed of 50 ft per min where sprayed babbitt has at least a 25% lower coefficient of friction than cast babbitt.

The curves, Fig. 5, show a general tendency for the coefficient of friction to fall to minimum with increased load and then rise again. This rise occurs rapidly with some metal combinations and more slowly with others. Using metal in the sprayed instead of the cast form results in lower friction and higher seizure loads. At a speed of 1000 ft per min seizure load increased from 5760 to 7040 lb per sq in, and at 3000 ft per min seizure load for cast babbitt was 3800 and sprayed babbitt 5120 lb per sq in. In general, static friction of the latter is about one third that of the former, the improvement being caused by the partial oil film trapped in the cavities.

Ahead of seizure load, Mr. Shaw's tests showed, cast babbitt reaches a point of frictional instability in which the friction, measured by a delicate testing machine, fluctuates considerably. This condition did not appear with sprayed babbitt, presumably because the cavities act as reservoirs and, by seepage effect from surface heat, continue to supply sufficient lubricant to preserve the film. Temperature at the immediate surface of a bearing can,

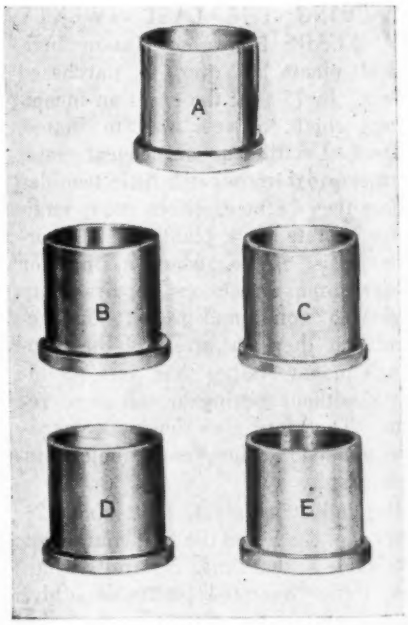


Fig. 1—Bearings of 100% sprayed metal answer repair problem

* Information supplied through the courtesy of the Metallizing Engineering Co., Inc.

Strength in Lb per Sq In.

Bushings made for tests	*Elastic limit*	*Yield: strength to 0.002-in. set*	*Compression strength*
1	44,000	53,100	78,850
2	25,050	26,670	53,100
3	19,140	21,350	30,600
4	7,590	8,125	15,100

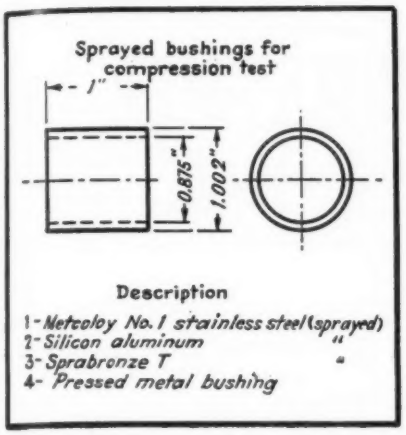


Fig. 2—Dimensions and composition of metal bushings tested to failure

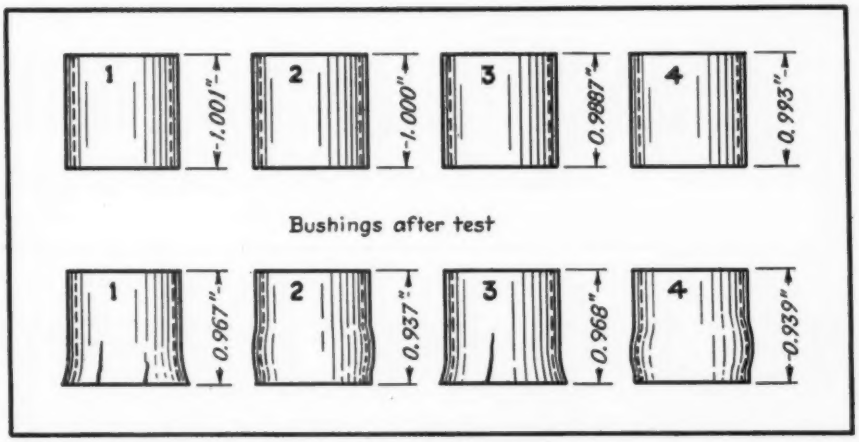


Fig. 3—Bushings 1 and 3 failed by spreading and splitting at one end, 2 and 4 failed by bulging. All proved strong enough to be pressed into a housing

under ordinary running conditions, reach a value equal to that of the metal's melting point. Such heat can cause expansion and possibly vaporation of oil held in the fine cavities of the sprayed metal.

Tests similar to those just described were made on a wide range of bearing metals, both cast and sprayed, with parts cut from ordinary production work rather than pieces especially sprayed for the purpose.

Although sprayed-metal bushings operate satisfactorily under load they must also be able to stand up under the force applied to press them into place. Since sprayed metal had not been used extensively as a separate or solid object, tests were conducted to study their compressive strength under conditions closely simulating the actual stresses imposed by an arbor press.

For this test three sprayed metal bushings were made up, Fig. 2., No. 1, was of Metcoloy No. 1 stainless steel, No. 2 of silicon aluminum, and No. 3 of Sprabronze T. A fourth bushing, No. 4, of pressed powdered bronze, was a standard commercially manufactured item. Pressed powdered-bronze bushings have been used so extensively and successfully that one was included in the test as a yardstick to indicate the probable strength that would be satisfactory.

Plungers were made to fit each end of the bushing to simulate the fittings usually found on an arbor press. They were one inch in diameter with a 7/8-in. extension, 3/32 in. long, to fit the internal diameter of the bushing. Bushings were placed in a compression machine and compressed to failure. Units 1 and 3 failed by spreading and splitting at the end, while 2 and 4 failed by bulging, Fig. 3. Test results are tabulated in the table on preceding page. All bushings were sufficiently strong to be pressed into place with considerable force even under adverse conditions.

When large numbers of small bushings must be replaced because of wear on their inside diameter the used ones can be restored to size by extrusion and metal spraying.

First find a thick steel plate to serve as the die. Drill several holes of progressively smaller diameter through the plate so that extruding the bushing through them in proper sequence brings it down to the correct inside diameter. To secure best results taper-ream each hole and polish the internal surface so that bushing enters easily and passes through with least frictional resistance. Harden the plate to reduce wear on the hole walls.

To restore the internal diameter insert a bushing in the largest hole and force it through with a hydraulic press. Continue through the remaining holes until the bushing's internal diameter is small enough to be reamed to correct size. Then metal spray the outside diameter and machine to its final size.

Fig. 4—After rough machining the bushing to size, drill necessary oil holes. Permit bushing to assume normal temperature before making final outside cut

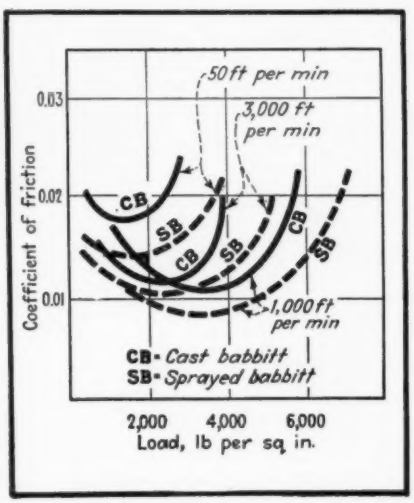
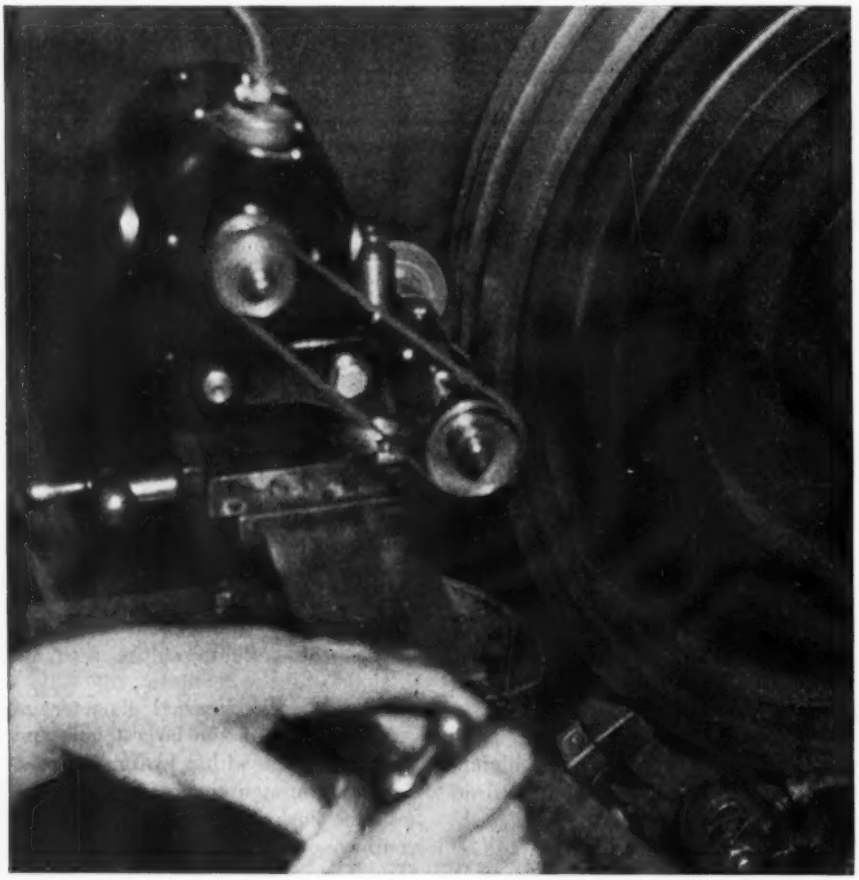


Fig. 5—Typical friction and seizure curves for cast and sprayed babbitt

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men

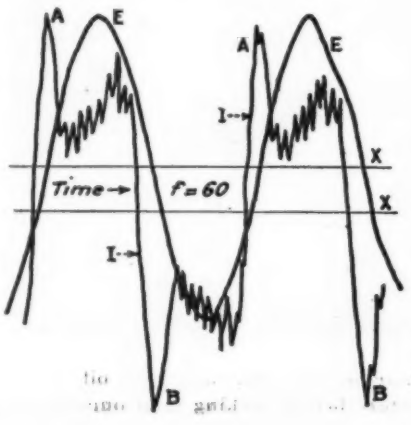


TRUING SLIPRINGS CURES VOLTAGE TROUBLE

THE CAST-IRON SLIPRINGS on our large steam-engine-driven alternator wore badly out of round. These rings are 24 in. in diameter and operate at 200 rpm. To true the rings we mounted a high-speed motor-driven grinder on an improvised machine slide rest, as in the photo. It was necessary to remove about 0.1 in. of metal in places to make the rings smooth and round. Grinding required about three hours, using a 2 x $\frac{3}{8}$-in. carborundum wheel.

Before grinding the sliprings our automatic voltage regulator gave us a lot of trouble. Relay contact points would burn and sometimes weld together and burn out resistance coils on the switchboard. This required weekly repairs and adjustment. Even tungsten points would last only a few days.

Since truing the generator's sliprings several months ago we have had no trouble with the voltage regulator. My explanation of this is that while an alternator is supposed to generate a sine voltage and current wave, a busbar oscillogram looks something like the diagram. Here the voltage curves *E* are quite smooth, but the current curves *I* are badly distorted. This distortion may be caused by influences outside the generator, such as resistance, inductance and capacitance of the circuits or from unsteady excitation current.



My guess is that the voltage regulator trouble was caused by the high-current peaks like *A* and *B* synchronizing with the regulator-relay contacts closing and causing them to weld together. Maybe some readers have a better explanation; if they have I would appreciate hearing from them.

This experience seems to indicate that if the sliprings on an alternator and commutator on the exciter are kept in good condition to maintain a smooth exciting current, busbar voltage will be easier to regulate and the voltage regulator give less trouble.

Rolla, Mo. A V KILPATRICK

What Made the Generator Tick?

A TICKING SOUND developed in a 200-kw 24- and 120-v 3-wire dc generator driven by a corliss engine at 125 rpm and used for night and Sunday service. Like the tick of a large clock, it would follow the generator revolutions for a few seconds, cease for about an equal period, and then repeat.

When we stood near the commutator the tick appeared to come from it, but when the ear was near the brushes the noise seemed to be in the armature coils. We examined the commutator for high bars, tightened its V-ring bolts and the wedges in the armature slots. When these efforts failed to remove the cause we trued and polished the commutator and removed shims from behind the polepieces to increase the air gap, but the tick persisted.

Next we considered the possibility of a cracked armature shaft. We inspected the shaft carefully for indications of its movement in the arma-

ture hub and gave it a whitewash test, but found nothing suspicious.

We discovered that when the engine was turned slowly with steam the tick appeared to come from the flywheel. We therefore carefully inspected the entire area of the wheel and its shaft, using a magnifying glass on any suspicious areas. The flywheel insurance company was notified and its representatives inspected the engine at various times. One day one of them told me that he could produce a similar tick by pressing together two of the commutator-bar risers and releasing them. We then assumed that cracking of the dried varnish on the risers had caused the tick.

To check this assumption we called in one of the generator builder's engineers, who diagnosed the cause as a loose nut or other object inside the commutator. However, a study of the armature drawing showed practically no clearance between the commutator V-ring and the armature-spider hub. This exploded another theory.

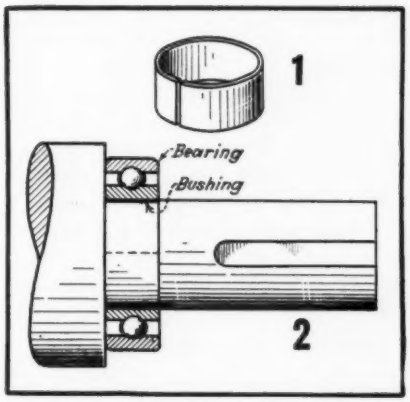
The noise continued for about two years, then gradually ceased, and has not returned for a like period. Perhaps some fellow engineers have had similar trouble and found the cause. If so I would like to hear from them so that if the tick returns I can stop it.

Ramsey, N. J. R W RIORDAN

Split Bushing Tightens Bearing on Its Shaft

THE INNER RACE of a ball bearing worked loose and turned on its shaft. Before the fault was discovered the race had badly worn the shaft. This condition was made more serious because the shaft extension outside the bearing was the same diameter as the race's inside diameter when new. The problem was to increase the shaft diameter to its original size. With welding or metallizing equipment this would have been easy but we did not have either and had to find some other expedient.

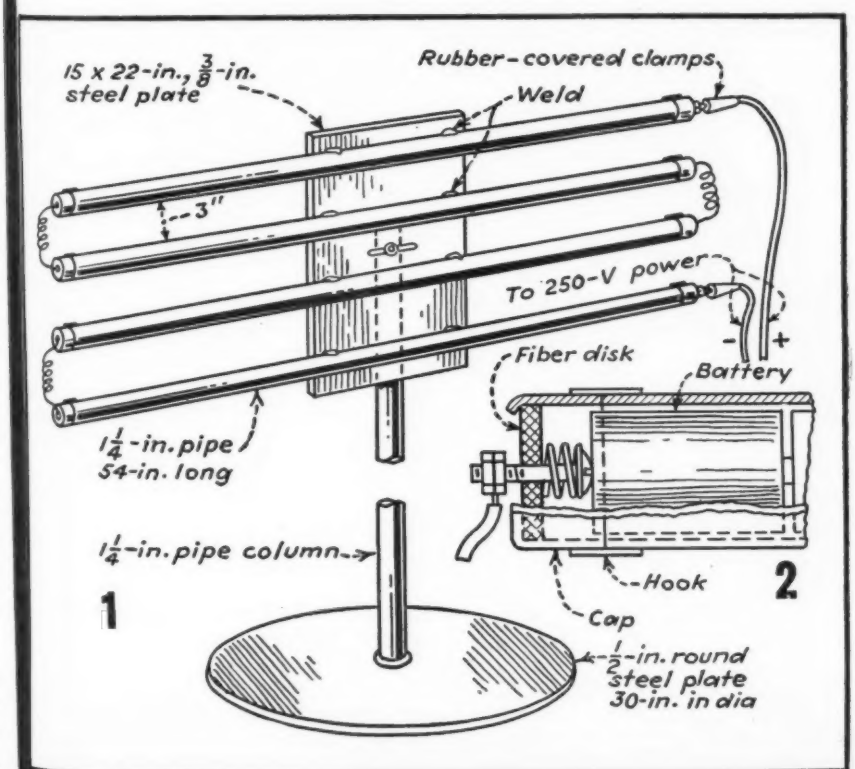
We put the shaft in a lathe and turned the worn section smooth and round. Then we made a bushing, Fig. 1, with an outside diameter equal to the full diameter of the shaft and an inside diameter a drive fit for the reduced shaft diameter. We then split the bushing and sprung it over the shaft, pushed it back and allowed it to snap on the reduced shaft section. The bearing was then forced home over the bushing, Fig. 2, to make a tight fit. The job has been in service for several months and works as well as when new.



Chicago, Ill. R C HENDERSON

HOMEMADE CHARGER REVIVES FLASHLIGHT BATTERIES

RECHARGING flashlight batteries is generally considered uneconomical and impractical but one company using large numbers of them has found that about 80% can be revived and has developed a method of doing the job. As shown in Fig. 1, the charger consisting of four 54-in. lengths of 1¼-in. pipe arranged horizontally and tack welded to a ⅜-in. steel plate. A ⅝-in. bolt in the 1¼-in. pipe-column top supports the plate and the charging tubes.



Each end of the tubes is closed by a cap with a contact in its center. Fig. 2 shows a cross-section through one of the caps. The body of the cap is a short length of 1¼-in. pipe with a fiber disk secured in one end. A contact bolt in the center of the disk has two nuts on its outside end for a connecting wire and a spring on the inside end to hold the bolt in contact with the batteries.

Two short hooks welded to the cap lock it to the end of the charging pipes on two short lengths of welding rod, spot welded to the pipe. Each tube length was selected to hold 25 batteries. We found, however, that in some cases the tube was too long for 25 batteries and too short for 26. To compensate for the short batteries we made three short metal plugs, insulated on their circumference that could be placed between the contact and the last battery in the charging tube.

In this system the four tubes, or 100 batteries, are connected in series on 250 v. The batteries are charged at a rate of less than 1 amp for 30 min and are placed in the tubes so that the current enters their center electrode. All batteries testing less than 1 amp before reviving are discarded and those testing less than 3 amp after reviving are

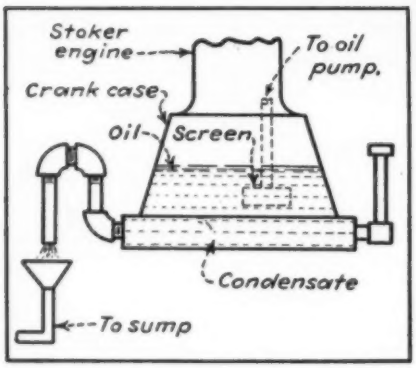
likewise thrown out. It has been found that about 80% of all batteries can be revived.

This equipment probably is too large for most plants, but it can be easily arranged to suit any conditions. The chief thing to remember is that if a flashlight battery tests 1 amp or more it generally can be revived by passing a 1-amp current through it for 30 min. If you cannot get new batteries try reviving the old ones.

Aliquippa, Pa. J N PORTER

Drainer for Stoker-Engine Simplifies Operators' Duties

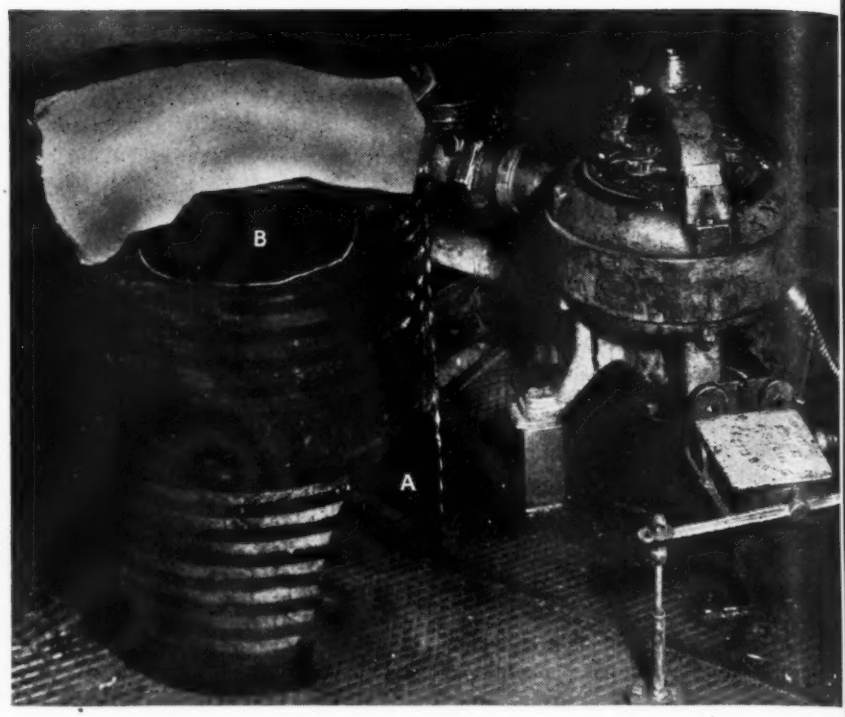
TO HELP RELIEVE the boiler operators of unnecessary duties we made and installed on the bases of our stoker



steam engines a simple automatic condensate drainer. Formerly, draining condensate from the engine bases by a pan-and-faucet method required that the operator stay close by until the condensate drained out. With this new method, condensate drains automatically from the engine base by overflow, the oil remaining at a predetermined level.

The drawing shows how pipe nipples and elbows were fitted together to make the drainer. Since installation, it has relieved operator of doing the draining, has saved considerable oil, and increased the time between oil changes in the engine. The operator used to carry away the condensate in a pan, but it now drains away to a lower-level sump.

Detroit, Mich. RICHARD BROWN



DRUM PROTECTS PUMP MOTOR

OUR SUMP PUMP is driven by an open vertical dc motor. This is one of the most difficult applications for a motor of this design. Vapors and fumes from the liquids coming into the sump were continually being deposited on its windings and commutator. As a result the motor required a great deal of attention to insure its operation.

To protect the motor we first made the sump cover vaportight below the motor. We found that a metal container the size of an oil drum shown at the left in the photo, would fit over the motor. We cut one head from this drum and cut its bottom edge, as at *A*, to fit around the motor connections.

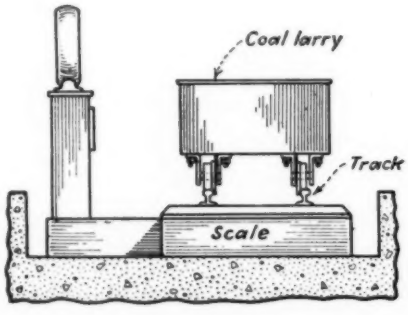
The drum gave the motor ample protection, but we had to remove it to inspect the commutator and brushes. This problem was solved by cutting a hole, *B*, in the drum's side at the commutator. This hole is kept covered with a piece of cloth attached to the drum's top. The cloth filters out all dirt and vapors and permits easy access to the commutator. Providing the motor with this protection eliminated all former troubles with it.

Ramsey, N. J. R W RIORDAN

Weighs Coal on Platform Scale

IN ONE PLANT where I worked we did not have a means of weighing coal to the boilers. The boilers were hand fired from a coal larry, which was loaded in the coal bin and pushed to a position in front of the boilers. We eventually succeeded in getting the management to buy a platform scale of sufficient capacity to weigh the larry loaded with coal.

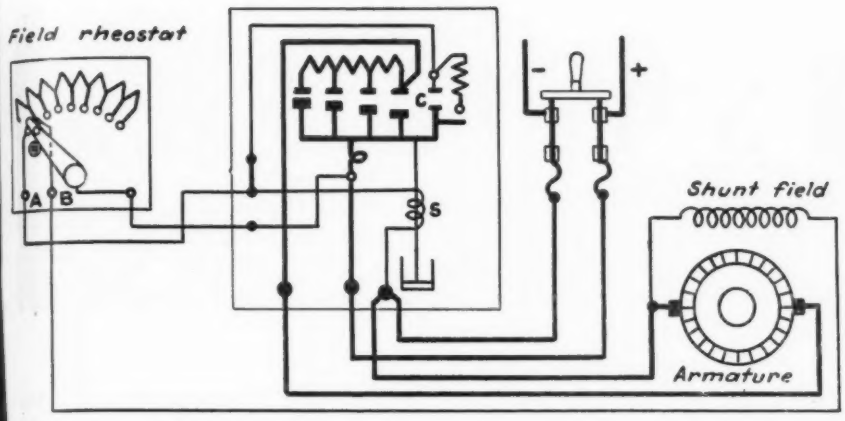
This scale we set in the concrete floor below the coal larry tracks, as in the drawing. We cut a section from each rail and bolted it to the scale platform so that the loaded larry could be run on the scale and weighed. In this way we kept an accurate record of coal burned from which we could closely check boiler performance on each of the three shifts.



MARTIN N GOZDENOVICH
Fairview, N. J.

Interlock Field Rheostat with Motor Starter

WE HAD TO INSTALL a 10-hp 230-v 900- to 1800-rpm dc motor on a machine requiring adjustable speed. All that was available for a controller was a time-



limit acceleration starter and a field rheostat. After installing the equipment we discovered that the operator was starting the motor without returning the field rheostat to off position.

To prevent starting the motor with the field rheostat in a highspeed position we arranged the connections as in the diagram. We broke the resistance connection to the first contact on the rheostat. To this contact we connected one terminal of the starter coil *S*. We also located the stop on the rheostat so that when the arm is in off position its contact shoe bridges the first two contacts. In this position the rheostat arm completes the field-coil and starter-coil circuit.

These circuits are from the + side of the line to the rheostat arm, then from terminal *B* through the shunt-field winding and to the — line. From *A* terminal the starter coil circuit is completed to the — line. When the starter reaches the on-position, auxiliary contact *C* closes a holding circuit around *A*. This circuit is from the + line to contact *C* through coil *S* and to the — line. Closing contact *C* permits the field rheostat arm to be moved from the first point to adjust speed and not open coil *S* circuit.

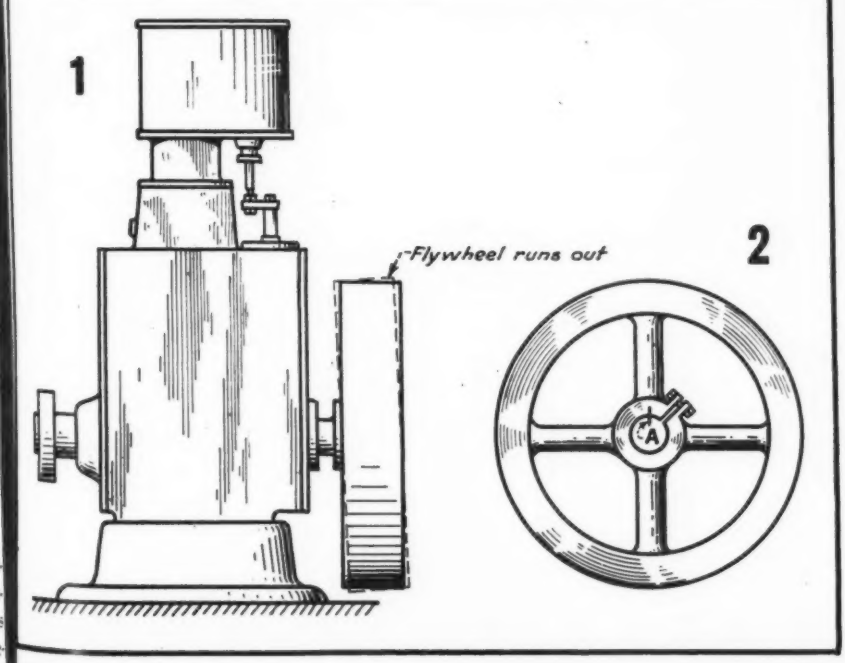
Chicago, Ill. J B MULLINS

TAKING THE WOBBLE OUT OF FLYWHEELS

ON SEVERAL SMALL ENGINES and compressors I have found the flywheel wobbling horizontally during rotation, as indicated in Fig. 1. When the flywheel is not keyed to the shaft I have also found that it generally could be turned to a position where it would run true.

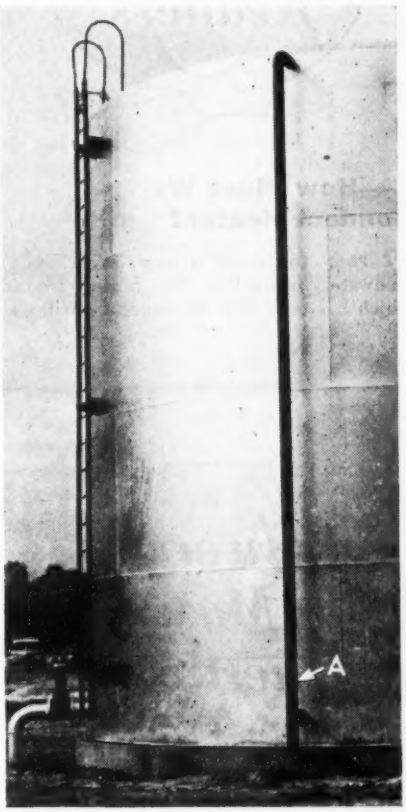
Mark the end of the shaft and flywheel as at *A*, Fig. 2, loosen the hub clamp bolts and turn the wheel on its shaft through a small fraction of a revolution. Tighten the clamping bolts and slowly revolve the engine or compressor. If the amount you move the wheel does not improve its running, repeat the operation until the best running position for the wheel is found.

Flushing, N. Y. S M ELONKA



Brings Tank Vent Down to Foundation

FREQUENTLY the vent on a water tank consists of a short nipple extending horizontally from the side of the tank near its top. If the tank overflows, the water runs down its side and in time discolors it, particularly if the surface is nicely painted. A horizontal stub pipe also provides a nesting place for birds, the old nests sometimes being pushed into the tank by air going in when the water level drops.



To eliminate these conditions one company extends the overflow on its raw-water tank down below the concrete foundation as at *A* in the photo. This insures carrying overflow below the nicely painted tank and also prevents birds nesting in the pipe. A bracket clamp welded near the tank's base securely holds the lower end of the pipe against movement.

Houston, Texas CHARLES C LYNDE

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

Questions from Our Readers

1—How Must We Connect Heater?

WE PLAN to install a new 3x7-ft open feedwater heater in the boiler room, which has only 21-ft clearance from floor to roof. At present our vacuum-return pump discharges into a 2x6-ft vented receiver.

I plan to mount the condensate tank up near the roof so that water will flow to the heater through a float-controlled valve (in the heater) by gravity. To prevent steam binding, the feedwater pump requires at least 8-ft positive suction head. With the heater mounted this distance above the pump, will water flow from the condensate tank into the heater if 1½- to 4-psi backpressure is maintained in the latter? What is the best way to arrange these units and maintain a reasonable backpressure in the heater?—*BSA*

2—What Becomes Of the Flyash?

WE HAVE one 1500- and four 1000-hp boilers and are adding two 1500-hp units, all to be fired by underfeed stokers. Because the plant is inside the city limits we are also installing flyash collectors. The problem now confronting us is disposal of the flyash from the collectors.

It has been suggested that we (1) flush it into a storm sewer (2) pump it to a dump (3) discharge it into the ash hopper (4) discharge it into the furnace or (5) feed it into the stoker hopper with the coal.

Disadvantages of these methods are: (1) There is no river nearby. (2) Ash is free to blow over surrounding areas when it dries. (3) Fan engineers say that the flyash, rather than falling into the ash hopper, recirculates and adds to the wear on fan blades. (4) Feeding flyash to the stoker hopper may lead to burned grates. If there are no other means of disposal which of the methods mentioned is best suited to our plant?—*PRM*

Answers to May Questions

Will the Motors Work in Parallel?

(This is Question 1 from the May issue, with best answers from readers)

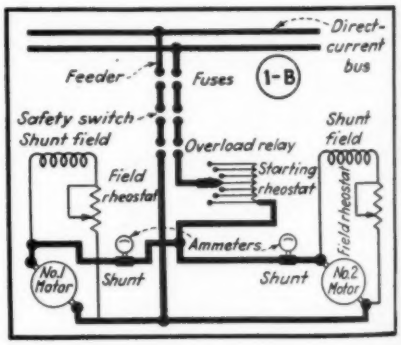
We have a compressor that requires a 50-hp drive but are unable to secure a motor of this size. It has been suggested that we remove two 25-hp shunt-wound dc motors from idle machines and use them for this drive.

Space is available to arrange the motors for belt drive either with one driven pulley and one belt running on top of the other or with two parallel driven pulleys. One 25-hp motor can start the machine unloaded but both have to be energized before compressor is loaded (machine is fitted with solenoid-operated unloaders). Since both motors are to drive the same load, overload relays can be connected to trip individual circuit breakers or one common to both motors in the main feeder.

Will the drives prove equally satisfactory? Also, how should the motors be connected electrically? Must both starters be mechanically connected so that they move in unison? Will we need a vernier rheostat in one motor's field circuit to better equalize the load? Can unloaders be wired to operate automatically? List other precautions.—LCL

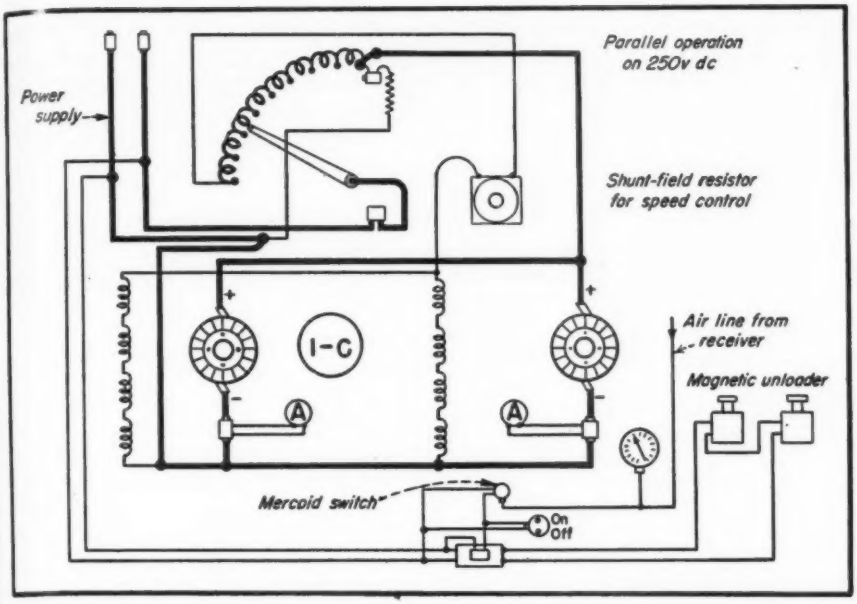
Make Electrical Hookup Simple

THE TWO 25-HP MOTORS can drive the compressor. One driven pulley with one belt running on top of the other would be an ideal setup. Many installations of this kind are operating successfully. I suggest LCL use 2-ply leather belts and apply a good brand of belt dressing to preserve the leather and keep it in pliable condition.



Regarding the electrical hookup, the simpler it is the less likelihood is there of operating trouble. Connect both motors through one starting rheostat, sketch 1-B, and have a rheostat in each motor field circuit so that the load can be equally divided between them. An ammeter in the positive lead of each unit will indicate the load.

Employing two motors makes it advisable to discontinue using the solenoid-operated unloaders. A good mechanical unloader operates fully as effectively and eliminates the need of constant supervision.



In starting, nearly all of the resistance should be cut into the field circuits. After starting rheostat is in running position adjust the shunt fields to give correct speed and load.

West Duluth, Minn. E R WEBBER

Adjust Speed by Moving Brushes

SKETCH 1-C SHOWS the wiring for operating two motors in parallel. LCL should purchase one starting rheostat to serve both motors. One belt can ride on the other with motors set one behind the other leaving enough space for belt adjustment. Both motors must have the same no-load and full-load speed and motor pulleys the same size. Check speed at half-load by running compressor with one motor and at no-load speed with compressor unloaded. Run each motor separately under these conditions and advance or retard brushes to obtain same speed and armature current for the same load.

One precaution in starting is to have shunt-field resistance all out because with a weak field the motor takes too much current. Contact buttons can be marked with motor speed at various points by checking with hand tachometer. Circuit breakers can be wired with a direct-acting magnetic trip, solenoid trip in series with the line, or shunt trip in parallel with the line, or the overload coil can trip the starting box handle.

No. 1 motor will run slightly faster than No. 2 because its belt rides on the other—making the equivalent of a bigger flywheel by an amount equal to belt thickness. This is taken care of when checking speed and load with each motor. Having one field rheostat in series with the two shunt fields in parallel is more practical, when two motors drive one mechanical load, than individual field rheostats to adjust their speeds, because the resulting speed changes may be too great.

Ottawa, Ont. G BONGIORNO

Either Drive Is Satisfactory

THERE IS NO REASON why two 25-hp shunt-wound dc motors cannot drive a compressor requiring 50 hp. It makes little or no difference which method is used to connect the motors mechanically to the compressor. If one motor can start the compressor unloaded, let that unit bring the other up to speed. Then it can be energized. Motors can be connected in a conventional manner, presumably with a starting rheostat in the armature circuit. Starters need not be mechanically connected. If LCL is satisfied with using one motor only, and always that motor for bringing the unit up to speed, it is possible to eliminate the starting rheostat of the second motor.

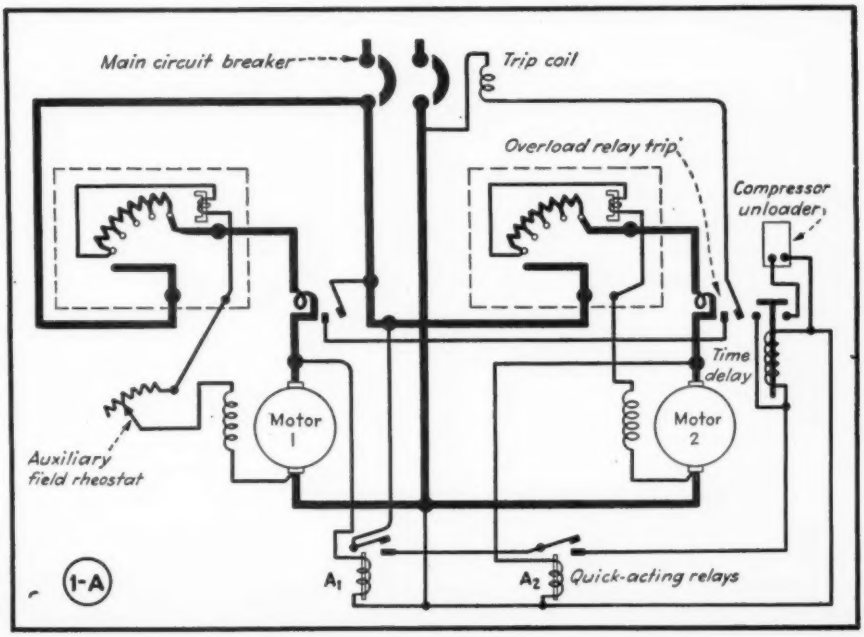
It will be necessary to provide a resistance of fine adjustment in the field of at least one motor. When load is placed on the compressor, the load between the two motors should be balanced by this rheostat. An ammeter should be provided for each motor to indicate loading.

Kalamazoo, Mich. E E NORMAN

Mount Starters Close Together

TWO 25-HP MOTORS should drive LCL's compressor satisfactorily. They should preferably but not necessarily be duplicates if their speed-load characteristics are similar. He should first connect the motors basically as in sketch 1-A, leaving out the auxiliary rheostat. The latter may not be necessary as the load may distribute equally between the two motors. Should one motor tend to take less than its share of the load connect the auxiliary rheostat in its field circuit and adjust to equalize the load. Once the proper setting has been found, a fixed resistor can be substituted.

It is not necessary to connect the starter handles mechanically so they move in unison. I advise against it because either should be able to trip



separately. However, mount the starters close together so that the operator can move both handles simultaneously when starting. Starting both motors at once divides belt strain and results in longer belt life.

Connect separate overload relays in the armature circuit of each motor and interconnect them to a main circuit breaker so that, if either motor is overloaded, both will be shut down at the same time.

Unloaders can be wired to operate automatically but: (1) Make it impossible to load the compressor unless both motors are operating. Do this by interconnecting relays A_1 and A_2, with the armature of each motor. Both must be closed before the compressor can be loaded. (2) Make certain that the compressor is up to speed before it is loaded. Using a time-delay relay, as shown, assures this.

It might also be advisable to consider electrically operated valves in the cooling-water lines to make sure that the compressor is not operated unless cooling water is flowing. Also a separately driven pulley for each motor is recommended. Belt life will be longer and it will be much easier to oil and inspect the motors in operation.

Elmira, N. Y. M H Elkin

Couple Motors Together

Using one driven pulley and two belts, with one belt running over the other, one motor must either run faster than the other, or have an odd-sized pulley since the diameter of the driven pulley is increased by the thickness of the first belt. Slippage would be a constant headache, although belts are operated in this manner.

Most satisfactory drive would be to place the motors in line with the pulley ends together, and couple them with a solid coupling that would then serve as the pulley. Strict attention to alignment and running position of the armatures would be necessary to avoid overheating or bearing trouble.

No. 1 motor can be energized through a starter to bring both motors and compressor up to speed. Wire second motor with a 3-pole magnetic contactor which has been reconnected to have its solenoid fed from the motor side of No. 1 motor starter. The solenoid circuit is then closed manually with a push-button, thereby connecting No. 2 motor to the line. Motor is already up to speed so full line voltage may be applied at once. Two poles of the 3-pole contactor connect the motor to the line, while the third energizes one line to the solenoid-operated unloaders. Other solenoid lead ties to one of the motor leads. Closing the circuit to No. 2 motor loads the compressor.

Each motor should have a suitable protective device. Fuses can serve for No. 1 motor, and the No. 2 motor contactor be fitted with heater relays. Provided both motors are duplicates, no form of field control for load-balancing is needed. Take ammeter readings, and if objectionable unbalance is indicated, insert a rheostat in the field of one motor.

Hanover, N. H. A L Waterman

Use One Motor For Starting

Electrically this problem presents no difficulties. The two 25-hp shunt motors will divide the load equally when the shunt fields are properly adjusted. Either belt scheme can be used: (1) one pulley with overriding belts or (2) two pulleys. Overload relays should trip the main circuit or, if more convenient, they can be wired to trip both motor circuits. For the latter scheme, see that both trip at the same time. I suggest that the compressor be started with one motor, the other one cut in and the load balanced between them by adjusting the shunt-field rheostats. The unloader is usually operated by a pressure switch. This can be operated by an auxiliary switch wired to operate from the starter or by hand. A centrifugal switch can be wired to unload the compressor at low speed and to cut in, in series, with the pressure switch when speed is normal.

Carlsbad, N. M. E A Roberts

Use Adjustable Motor Sheaves

The 50-hp. compressor can be driven by two 25-hp dc motors provided the proper kind of drive and control is used. If compressor has dual belt wheels of equal diameter belt one motor to each wheel. If it has only a single pulley, belt the motors to a jack shaft and the shaft to the compressor. A V-belt drive should prove the most satisfactory, and if used with adjustable motor sheaves they can be adjusted so that motor loads are balanced.

If one belt rides over the other it will probably be difficult to divide the load on the motors accurately without using a balancing rheostat in the field winding of one motor. There is less danger of burning out the motors if they have individual starters that are linked together. Protect each motor with a reliable circuit breaker and overload relay. It is good protection to have the control circuit tied into the circulating water system. Thus, if water is not flowing the motors cannot be started, and if the flow stops the motors will be shut down.

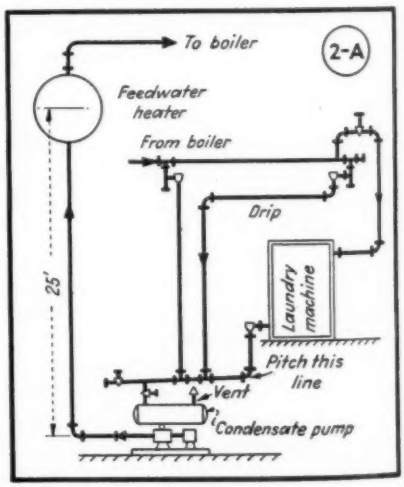
Oak Ridge, Tenn. I A Butcher

What Prevents Condensate Return?

(This is Question 2 from the May issue, with best answers from readers.)

We have a 2000-ft pipeline that returns condensate from the laundry to the boiler room. The line then rises vertically to enter the feedwater heater 25 ft overhead. A valve at the foot of the riser permits draining the line. A total of fifteen ¾-in. and six 1-in. traps (connected to the 100-psi steam main) discharge into the return.

When laundry returns from two mangles, two dryers, six pressers and a low-pressure steam generator are discharged into the return line all machines get cold within one hour. Upon opening the drain valve at the boiler-room riser considerable air discharges, then a slug of water, and again a pocket of air. Is poor operation caused by air leakage or is the lift too high? Suggestions for correcting this trouble will be appreciated.—CHH



Install Condensate Pump

It is obvious from the description of the piping system that both condensate and air are trapped in the return line. There may be several explanations for this unusually troublesome behavior:

(1) The return being underground might have sagged at places because of ground settling. Thus, peaks and valleys so formed trap the condensate and air.

(2) The line being so long (2000 ft) pressure drop may be excessive and flow sluggish.

(3) The 25-ft vertical riser to the feedwater heater may present too much hydraulic head for pressure in the horizontal run to overcome.

The fact that when the valve at the base of riser is opened alternate slugs of condensate and air discharge indicates that there is sufficient pressure upstream of that point to clear the condensate return. There can be no air leakage in since the system is under a positive pressure.

Solution of the problem is suggested by the visible effect when opening the valve at the foot of the riser. A vented condensate pump at this point discharging into the feedwater heater would maintain the return line clear of condensate and air. The accumulated air would, under these conditions, be vented to the atmosphere, sketch 2-A.

Initial heating of the machines in the laundry occurs because the condensate return acts as a reservoir and collects the condensate as it forms until the line becomes filled and circulation sluggish water then backs up and fills the machines so that steam no longer reaches the heating surfaces.

Cliffside, N. J. J D CONSTANCE

Install An Air Vent On the Riser

CHH DOES NOT GIVE the size of discharge line or whether there is any pitch in the line between laundry and point where discharge line rises vertically to enter feedwater heater.

By the time condensate reaches the riser there is not enough pressure left to lift the remaining 25 ft to the feedwater heater. To overcome the difficulty and keep laundry machines operating at 100% efficiency, he should install a steam-operated lifting or pumping unit. Such a unit handles condensate at any temperature and the oil-free steam needed for its operation (less than that required by a steam pump) can be passed to the vertical line and turned into feedwater. He should also install a high-pressure thermostatic trap on the riser to act as an air eliminator.

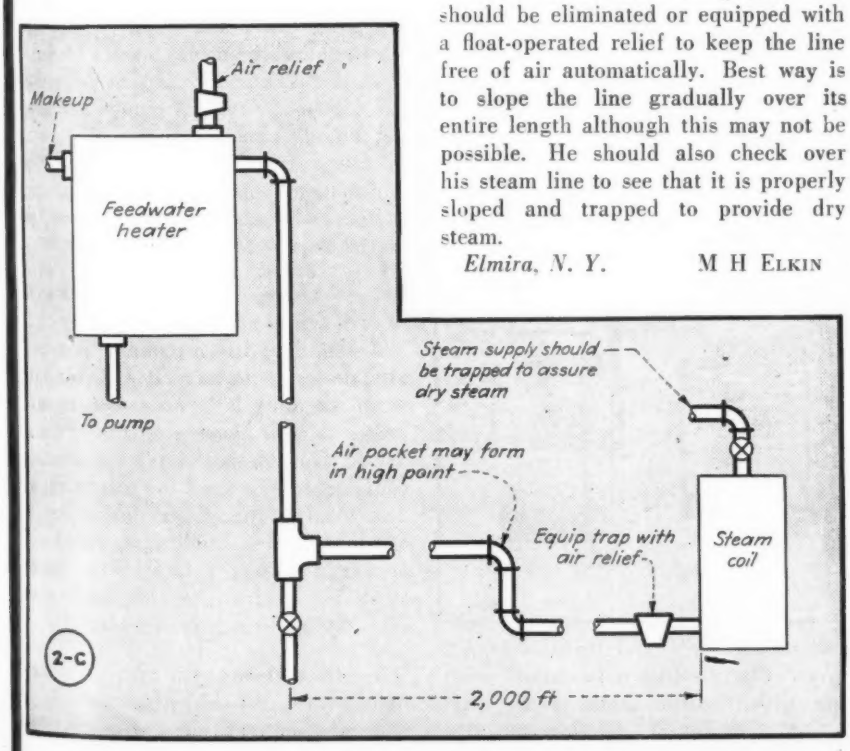
Boston, Mass. H W BRANDT

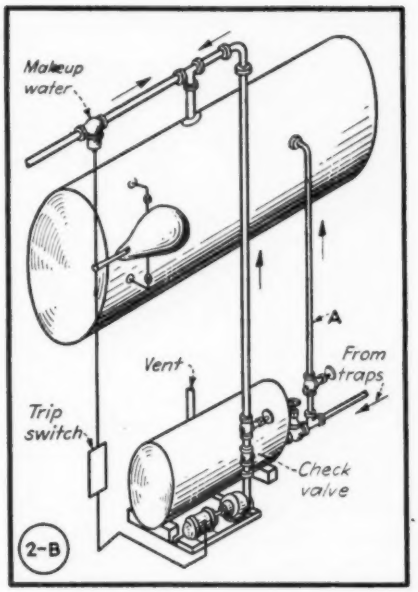
Suggests Some Automatic Air Vents

I SUGGEST that CHH take steps to free the condensate return of air by some automatic means and possibly make changes in the return line. The air can be released at the feedwater heater by installing a float-operated air-relief valve at the high spot.

Although the line appears to slope toward the heater it should be checked to see whether there are any high points in which air pockets can form, sketch 2-C. If there are such points they should be eliminated or equipped with a float-operated relief to keep the line free of air automatically. Best way is to slope the line gradually over its entire length although this may not be possible. He should also check over his steam line to see that it is properly sloped and trapped to provide dry steam.

Elmira, N. Y. M H ELKIN





Why Not Have the Feedwater Tested?

THE FACT THAT a large number of traps from the h-p mains discharge into the same line as those from the l-p ones creates a condition whereby it is impossible to eliminate a head of cold water at the 25-ft riser. This water, whether going to an open or a closed heater, will at all times act not only as a backpressure against the discharge from all traps, but also as a cooling medium for the returns.

Thus, the h-p returns, discharging into this line, will be cooled immediately. The only water going into the heater will be that which overflows at the top of the riser as the various traps add to the condensate. The head of cold water remains, and it cannot be overcome by the l-p traps and other returns, thus cooling off the laundry equipment.

Remedy is to eliminate the head by having all returns led to a common tank or hotwell placed at the bottom of this riser and installing a pump to discharge to the heater. Number of traps and machines in operation would seem to justify this investment.

There is no possibility of air leakage causing the trouble because all lines are under pressure. The only possibility in this direction would be some form of noncondensable gas in the steam system. It may be well to have the boiler water checked by a reliable firm.

In sketch 2-B the pump control is operated by the heater float, which also controls the makeup supply from city mains. This control should be so ad-

(*Continued on page* 150)

CENTRIFUGAL PUMP Q AND A FOR POWER ENGINEERS

By I J Karassik and Roy Carter

5—*Couplings and Deepwell Pumps*

Fifth in a monthly series by Igor J Karassik and Roy Carter, Worthington application engineers. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—*What types of couplings connect centrifugal pumps to their power units?*

A—Flexible couplings are most commonly used but practically all types of couplings and clutches have been applied.

Q 2—*What is a rigid coupling?*

A—A coupling that solidly connects the driving and the driven shafts making of them, in effect, a single shaft. They are used mainly on vertical pumps and generally must be capable of transmitting torque and thrust, like Fig. 1.

Q 3—*What is a clamp coupling?*

A—It is a rigid coupling, which consists of a split sleeve with bolts so it can be clamped on the adjoining ends of two shafts to form a solid connection. Axial and circular keys are commonly used so that transmission of torque and thrust does not depend solely on frictional grip.

Q 4—*What is a compression coupling?*

A—Compression couplings are seldom, if ever, used on modern horizontal centrifugal pumps. Their use is normally restricted to vertical sump pumps. Compression coupling is essentially a rigid coupling with its central portion a slotted bushing, bored to fit the two shafts and tapered on the outside from the center to both ends. The two coupling halves are bored to suit this taper. When bolted together they compress the bushing to the shafts with a frictional grip that transmits the torque without keys.

Q 5—*What is a flexible coupling?*

A—A flexible coupling transmits torque from one shaft to another the same as a rigid coupling, but is of a design that permits minor misalignment, angular, parallel or both, of the shafts. Fig. 2 to 5 show four of many designs and the captions describe them.

Q 6—*What is an extension coupling?*

A—It is a flexible coupling consisting of two single-engagement elements connected by a sleeve. Fig. 7. This gives, in effect, the equivalent of a short floating shaft drive that compensates for greater misalignment than a regular flexible coupling. Extension couplings are commonly used on pumps handling hot liquids when expansion may cause misalignment. They are also used on end-suction pumps in which the impeller and bearing assembly are removed axially towards the driver.

Q 7—*What types of couplings are used in dual-driven pumps?*

A—On dual-driven pumps it is generally desirable to have one driver idle when the other is in operation, to save power as well as wear on the idle machine. Some design of quick disconnect coupling can be used for this purpose. The ideal coupling for dual-drives is one that can be readily disengaged and engaged. When the standby driver starts automatically a freewheeling or over-running clutch is necessary.

Q 8—*Are clutches used between centrifugal pumps and their drivers?*

A—Conventional designs of clutches

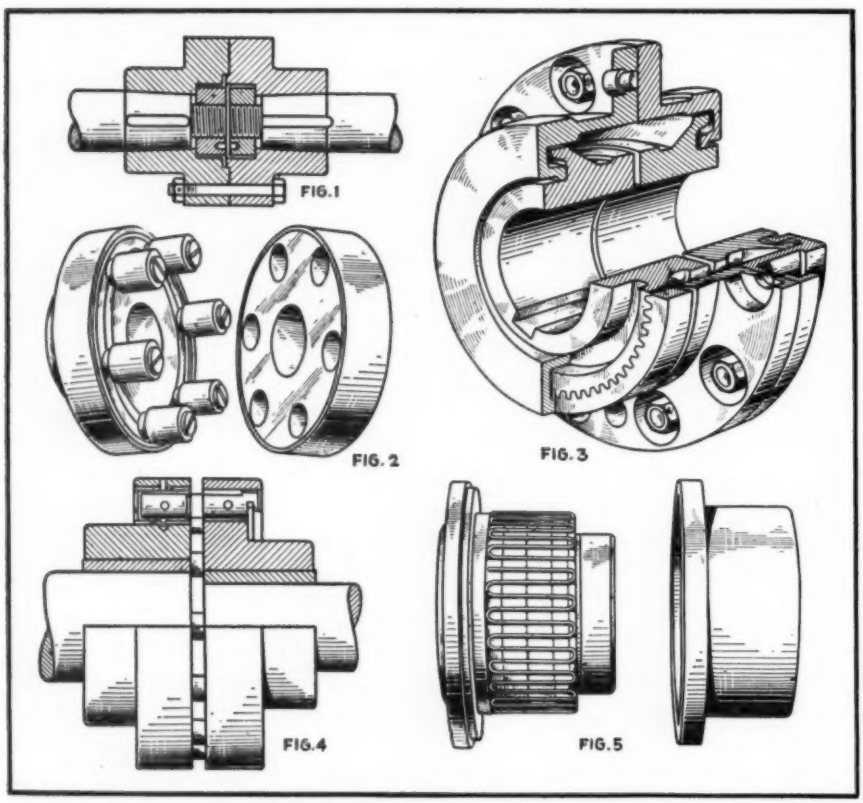


Fig. 1—Rigid coupling that transmits both torque and axial thrust. Fig. 2—Flexible coupling with rubber-covered pins. Fig. 3—Internal-external gear-type flexible coupling. Fig. 4—Coupling with flexible metal pins. Fig. 5—An all-steel coupling with a steel spring grid for its flexible member

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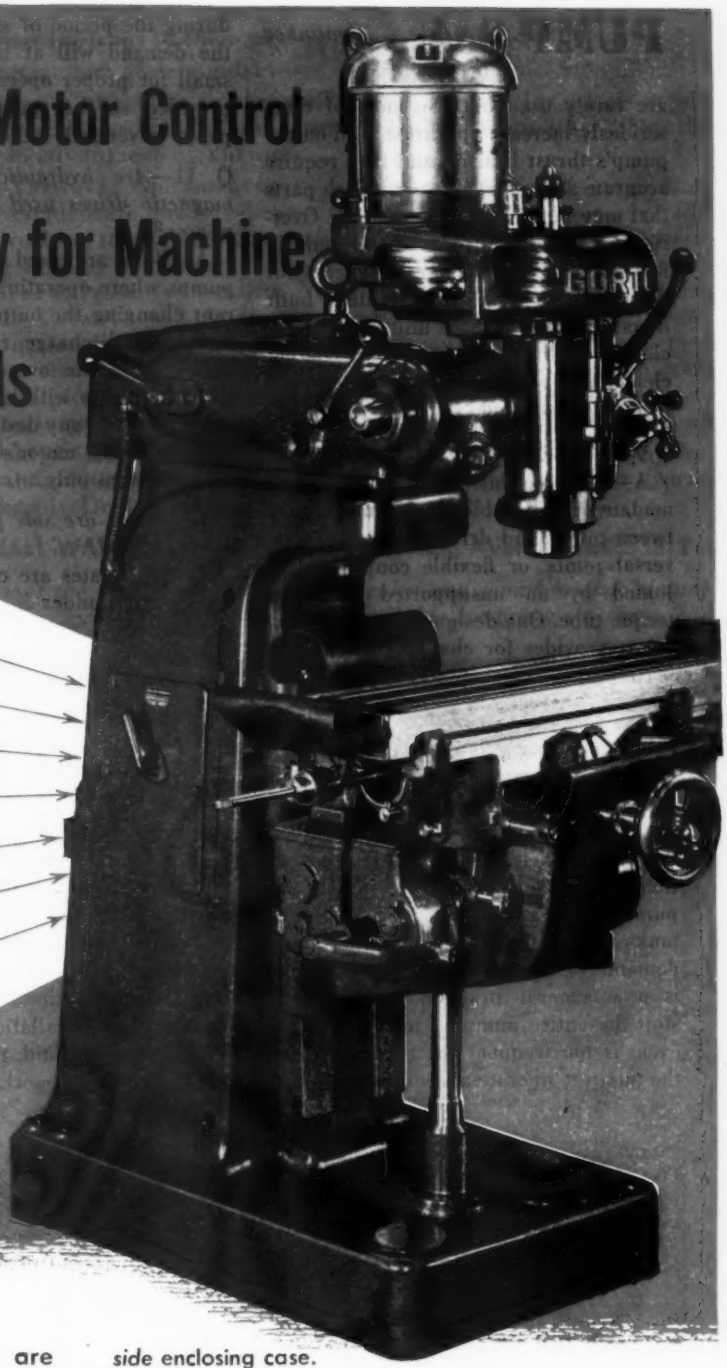

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C-H

Engineering excellence finds its greatest reward in the respect and confidence of those it serves

are rarely used because most of them seriously increase the thrust load on the pump's thrust bearing and they require accurate alignment between clutch parts that may be difficult to maintain. Overrunning clutches are used particularly for dual drives. The most successful designs have a flexible coupling built in as part of the clutch unit. Automatic clutch-couplings that have their friction elements applied radially by centrifugal force are also used.

Q 9—*What is a "flexible drive"?*

A—In some installations to accommodate considerable misalignment between pump and driver shafts two universal joints, or flexible couplings are joined by an unsupported shaft or torque tube. One design using universal joints provides for changes in distance between the shaft ends and is called a "flexible drive," Fig. 6.

Q 10—*Are magnetic clutches used with centrifugal pumps?*

A—They are rarely used to connect centrifugal pumps to and disconnect them from their drivers. One application where they have been used is on pumps discharging into accumulator tanks or for similar service where the demand varies over a wide range. It is now general practice to start and stop the entire pumping unit or, if the cycle is too frequent for that, to allow the pump to operate at reduced capacity during the period of small demand. If the demand will at times become too small for proper operation, a bypass is provided so that pump discharge capacity never falls below a safe value.

Q 11—*Are hydraulic couplings and magnetic drives used with centrifugal pumps?*

A—Both are used with centrifugal pumps where operating conditions warrant changing the output speed to control pump-discharge rate. They have about the same over-all efficiency as slipring motors with speed control and can easily give any desired output speed while slipring motor's control adjusts speed in steps only.

Q 12—*What are sole plates and when are they used?*

A—Sole plates are cast-iron or steel pads located under the feet of a pump or its driver, or both. They are embedded in the foundation and the pump and its driver are doweled and bolted to them. Sole plates are generally used for some of the larger units to save the cost of the large bedplates that would be required for such units.

Q 13—*What is the purpose of a bedplate under a pump and its driver?*

A—The purpose is to provide a foundation on which they may be aligned with each other and on which they can be assembled as a single unit for moving from one location to another and to simplify their installation. While bedplates are fairly rigid, they do not provide sufficient support, and must be bolted and grouted to a rigid foundation after being properly leveled. Because of handling during transit and erection, bedplates sometimes become distorted, which makes it necessary to check the unit's alignment after it is installed.

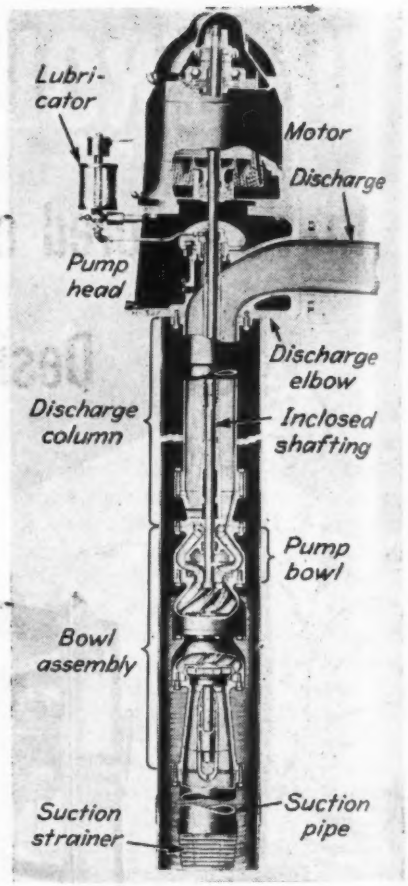

Fig. 8—Section through a deep-well pump with above-ground discharge

Q 14—*When is it undesirable to provide a bedplate under the pump and its driver?*

A—For most large pumping units, the cost of a single bedplate on which to mount and align the different parts exceeds that of the field work necessary to align individual bedplates or sole plates. In such cases a single bedplate is used only when appearances or the need as a drip collector justifies the additional cost. These bedplates have a raised lip around their top edge and slope toward one end to collect drainage in a screened drain pocket from where it is piped to a convenient point for disposal. Even for fairly small units there are installations where a considerable difference in height exists between the level on which the pump's feet are bolted and those of its driver. In many such installations a more rigid and pleasing appearing unit can be obtained by using individual

(*Continued on page* 138)

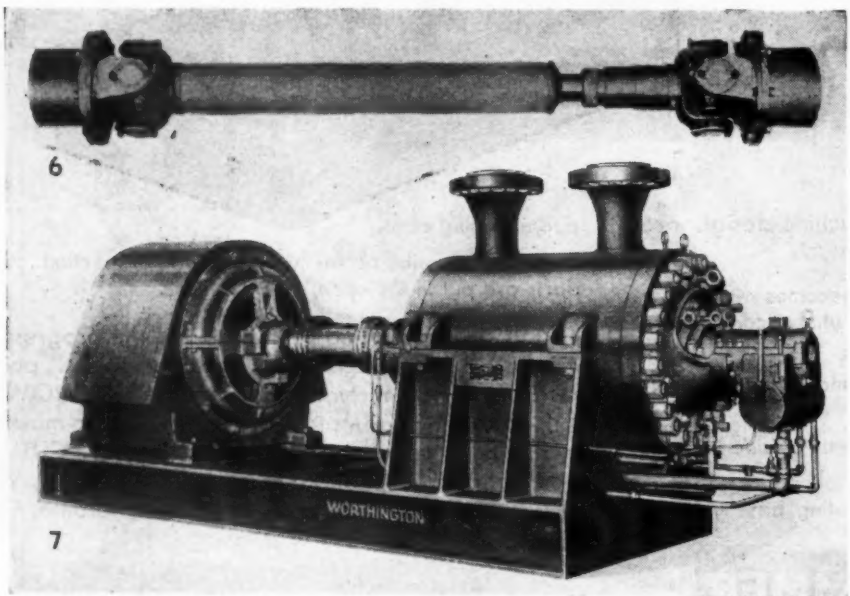

Fig. 6—Flexible drive consists of two universal joints connected by a torque tube. Fig. 7—Motor and high-pressure high-temperature multi-stage pump connected by an extension coupling, equivalent of a floating shaft, to compensate for greater misalignment than can be taken by conventional flexible coupling

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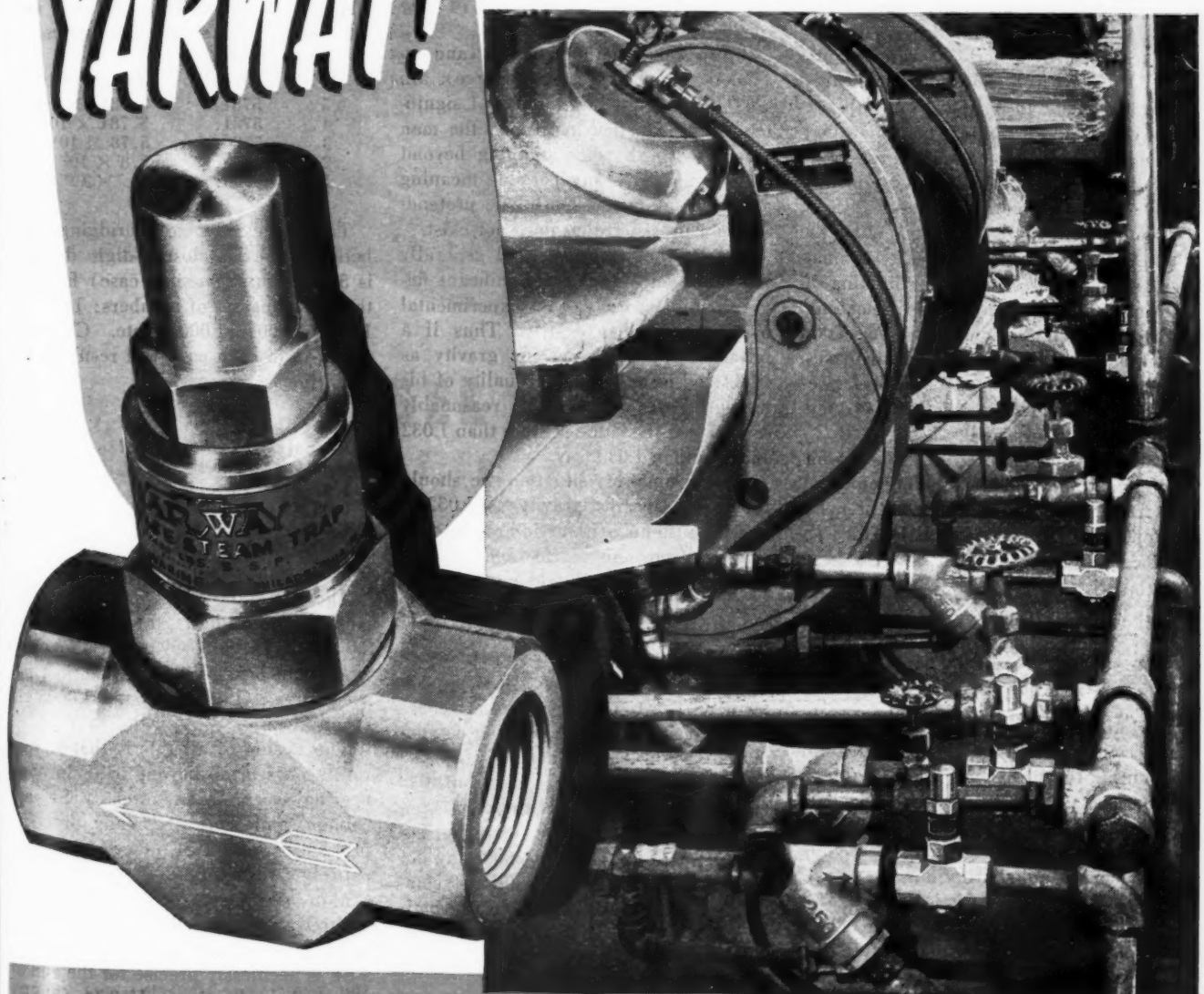

YARWAY IMPULSE STEAM TRAP

MATH TIPS

PHIL SWAIN GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

❷ — More About Significant Figures

BECAUSE OF THE IMPORTANCE of significant figures in all engineering work, this article is partly a review of the first installment (page 120, June, POWER) but with new examples and additional hints on the use of powers of ten.

The idea, promulgated in most public schools, that carrying computed results to a certain number of decimal places insures a certain grade of precision, is entirely false. In fact, carrying the result to only 2 decimal places may keep the error less than one thousandth of one percent in one case. In another, using 4 decimal places instead of 5 may introduce an error of 5%.

To get to first base as a computer the engineer must put aside this decimal-places nonsense and start thinking in terms that have some practical meaning, preferably significant figures. A certain number of them, unlike decimal places, represent a certain general order of percentage accuracy, whether the quantity be large or small.

To find the number of significant figures count all digits (including ciphers) starting with the first digit that is not a cipher. Let SF be shorthand for significant figures. Then:

2346.23	has	6 SF
2346.230	has	7 SF
0.000012	has	2 SF
496,302	has	6 SF
496,302.4	has	7 SF
1000.003	has	7 SF
1000.0	has	5 SF

The only exception to this rule for counting the SF occurs where the number has no digits after the decimal point, and where, *at the same time*, one or more digits *immediately* preceding the decimal point are ciphers.

There is a very practical reason for this. You can round the number 0.2843 to 0.28 if you wish to give only 2 SF, but you can't round off 2843 to read 28. You have to add the two ciphers in place of the 43, so the number reads 2800 when rounded to 2 SF.

But suppose the 2800 should just happen to be the true value. A man not familiar with the derivation, and seeing 2800, could not tell whether this mark actually stood for 2800, whether it was a 2 SF rounding of some such number as 2835, or a 3 SF rounding of 2804, say. This confusion will not occur where one reports 2800 in his own computations. He will then know whether it represents 2800 or a rounding of 2835 or 2804.

Professional mathematicians (and engineers to an increasing degree) are very fussy about the number of significant figures. They look upon the man who uses 5 SF where nothing beyond 3 SF could have any possible meaning as a sort of unconscious liar, pretending to a precision that does not exist.

A scientific researcher will generally put down only as many significant figures as the accuracy of his experimental measurements can justify. Thus if a physicist reports a specific gravity as 1.0324 he means that the quality of his measurements makes him reasonably certain that the value is more than 1.032 and less than 1.033, say.

If, knowing this situation, he should report the specific gravity as 1.03243, just because his arithmetic brought that answer from his measurements, he would feel that he should be "read out of the club" for false pretensions of precision, so to speak.

Engineers should apply the same idea more often, but they should go one step farther. The top limit on the arithmetical precision of an engineering computation should be set not only by the probable accuracy of the data but also by the use to be made of the results.

We have noted that the significant figures of such a number as 2800 may not be clear to the man who did not compute it. The professional mathematician gets around this confusion by his habitual use of powers of 10. In this system:

$10^2 = 100$	$10^{-1} = 0.1$
$10^3 = 1000$	$10^{-2} = 0.01$
$10^4 = 10{,}000$	$10^{-3} = 0.001$
etc	etc

With these tools the mathematician can always make clear the number of significant figures. If he really means 2800 he writes it 2800. If he means a number between 2000 and 3000, of which the first two digits are 28, he writes it 28×10^2. If he means a number between 2000 and 3000, of which the first three digits are 280, he writes it 280×10, or 28.0×10^2.

Here is another comparison of the two ways of representing numbers. This reports the number 5781.3 to various numbers of significant figures:

SF	*Usual*	*Powers of* 10
5	5781.3	5.7813×10^3
4	5781.	5.781×10^3
3	5780.	5.78×10^3
2	5800.	5.8×10^3
1	6000.	$6. \times 10^3$

To see the effect of abridging numbers where the closest digit dropped is 5 (the worst possible case) first test the following set of numbers: 1.5, 1.05, 1.005, 1.0005, 1.00005 etc. Chopping off the 5 in each case will result in the following errors:

Original number	*Final number*	*Final SF*	*Error percent (approx)*
1.5	1.	1	50%
1.05	1.0	2	5
1.005	1.00	3	0.5
1.0005	1.000	4	0.05

These are the worst possible errors from dropping digits. For a series like 9.5, 9.95, 9.995, 9.9995, etc, the error would run only one tenth that just figured for 1.5, 1.05, 1.005 and 1.0005 respectively.

The upshot of all this is that it very rarely pays to go beyond 5 SF in engineering work. Most often 4 SF are enough, and there are many practical problems where 3 SF or even 2 SF are entirely satisfactory.

Many engineers, for example, always multiply the diameter of a circle by 3.1416 to get the circumference although 5 SF is needlessly precise for the run of practical applications. If 3.14 (3 SF) is used the resulting error in the computed circumference of a 3-in. boiler tube will be less than 0.005 in. because $0.0016 \times 3 = 0.0048$.

37,325 HOURS OF SERVICE

BEARINGS READY FOR MORE

SUN DIESEL LUBRICANTS . . .

. . . reduce wear . . . keep rings free . . . cut maintenance

Here's a record of continuous operation that proves the efficiency of diesel engines and the lubricating ability of Sun Diesel Lubricants.

For more than four years the Buckeye diesel engine of a large Eastern manufacturer had been in continuous operation — 24 hours every day — except for short periodic inspection overhauls.

No replacements of bearings or liners had ever been made. The above photo is ample evidence of the excellent condition of the bearings when they were removed. After 37,325 hours of operation every bearing was ready to be put back into service again for many hours of extra operation.

Wear protection is an outstanding quality of Sun Diesel Lubricants as proved by performance data received from operators of all types of diesel engines. These modern lubricants help keep operating efficiency at its peak by preventing ring sticking, formation of hard carbon, gum and sludge.

For low cost operation and trouble-free maintenance, call in the Sun Engineer today. His recommendations and Sun Diesel Lubricants may be the answer to many of your maintenance problems. Write . . .

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REFRIGERATION NOTEBOOK — 23

Capacity Controls for Refrigerating Machines

By TERRY MITCHELL, ME, *Frick Company*

This is Part II of an article describing different methods of regulating refrigerating-compressor capacity. Part I ran in the June issue of POWER.

IN ANOTHER METHOD of unloading, the Kramer *Balance-Loader* system, a pressure-sensitive valve controls liquid-Freon feed to a coil placed inside a closed tank. Liquid in the coil boils and the resulting gas goes to the evaporator suction where it mixes with suction gas going to the compressor. Hot gas from the compressor discharge flows through the vessel on its way to the condenser. The effect is to balance the load smoothly, at the same time cooling the discharge gas enough to save condensing water that is so precious in many localities.

The method illustrated in Fig. 1 gives micrometer adjustment of compressor capacity. Here cylinder clearance is varied at will by moving the auxiliary piston back or forward in a pocket that connects directly with compressor cylinder. Opening a pocket that connects to the cylinder has the same effect as making the cylinder longer without changing the piston stroke. Then discharge pressure builds up later and less gas is forced over to the condenser.

Assume a cylinder fitted with a telescopic extension on the head end carrying racking gear so that it can be locked in any intermediate position between full and minimum extension. With the cylinder head almost touching the piston at the end of its stroke, clearance is practically zero and most of the gas is forced from the cylinder.

Conversely with the cylinder wall and head fully extended clearance is maximum and internal pressure during compression is less than that needed to discharge the gas.

Therefore moving the cylinder head toward the piston from its extreme outer position reduces the clearance volume by the amount moved, and causes a greater and greater amount of gas to be discharged. Using a connecting pocket and movable piston has the same effect as a telescopic cylinder. The cooling-water jacket also surrounds the clearance pocket.

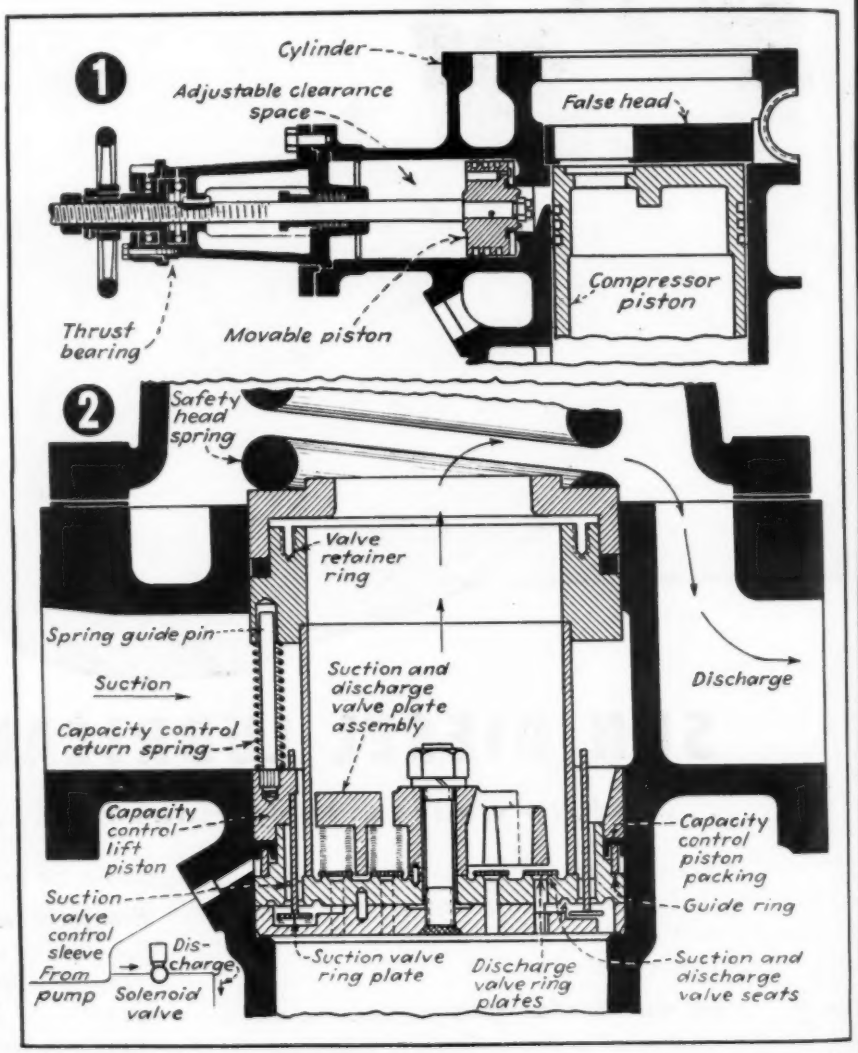


Fig. 1—Adjusting movable piston by hand increases or decreases the cylinder clearance. Thus compressor load can be regulated to suit refrigeration requirements. Fig. 2—Holding the main suction valve open unloads the cylinder completely because the gas is free to move back into the suction line during each compression stroke instead of out the discharge and to the condenser

To prevent the clearance-pocket piston from hammering at each stroke of the machine, the threaded stem nut turns between closely fitting ball bearings. Such capacity controls are best adapted to manual setting. Thus far they have been applied to ammonia compressors more often than to Freon-12 machines. The latter generally use the bypass arrangement of unloading.

Freon-12 units of larger size are now often designed with capacity control built directly into the cylinder heads, Fig. 2. This usually holds open the suction valves of one cylinder after another, unloading the machine in steps. Controls of this type are preferably arranged to unload, also, the entire machine both for the starting-up and shutting-down periods.

NEW! The EDWARD Intex UNIVALVE*

Newest addition to the Edward steel valve line, the Univalve is a forged steel globe valve for service to 1500 lb at 950 F. Body and bonnet are a single unit, the seat is integral with the body, and the inclined stem design and streamlined flow contours cut pressure drop to from 25% to 50% of that of most forged steel globe valves.

All the distinctive standard features of Edward valve construction are included—oversize knobbed handwheel, extra-deep stuffing box and cooling chamber, re-enforced EValpak molded packing, junk ring EValized for abrasion resistance, centerless ground EValloy stem—with the addition of many new features that make the Edward Univalve the best buy possible for high temperature, high pressure service.

**Integral seat valve with body and bonnet a single unit.*

1 WELDED BONNET

Patented leakproof welded body-bonnet joint, with backseating joint for repacking under pressure, and designed for disassembly if ever necessary.

2 INTEGRAL hard-faced SEAT

A continuous ring of Stellite applied directly to the body, machined in the same set-up with body bore for perfect alignment, and carefully mated to disk for full bearing area.

3 HARD FACED DISK

Heavy layer of ground and lapped Stellite on alloy steel disk.

4 BOLTED GLAND

Easy packing adjustment, with through-bolted, accurately guided gland.

5 BRONZE YOKE BUSHING

Minimizes wear and prevents galling.

6 ONE PIECE, Integral YOKE BONNET

Perfect alignment of working parts.

7 LOW PRESSURE-DROP FLOW

Edward inclined stem globe valve construction eliminates sudden changes of flow, reduces erosion-producing turbulence, and cuts pressure drop to minimum, yet retains desirable characteristic of globe valve tightness.

UNIVALVE SIZE RANGE
1500 lb —950 F

Screwed Ends
Fig. 2220—½", ¾"
Fig. 3220—¾", 1", 1½", 2"

Socket Welding Ends
Fig. 2224—½", ¾"
Fig. 3224—¾", 1", 1½", 2"

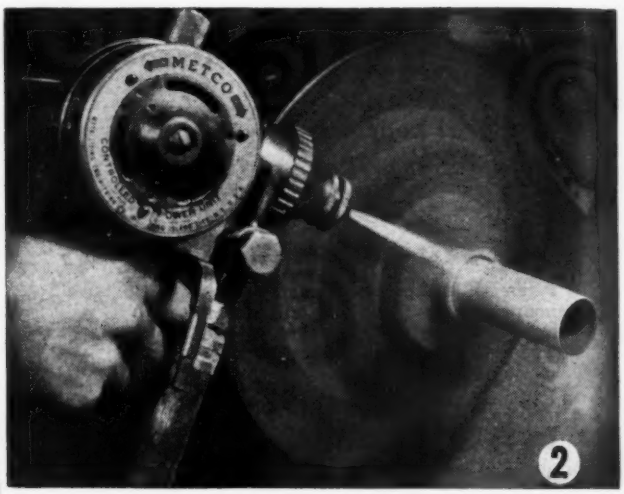
EDWARD *Steel* VALVES

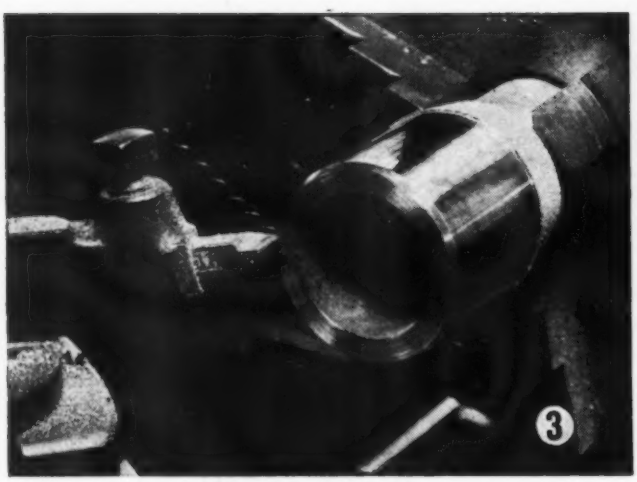
The Edward Valve & Manufacturing Co., Inc. • East Chicago, Indiana

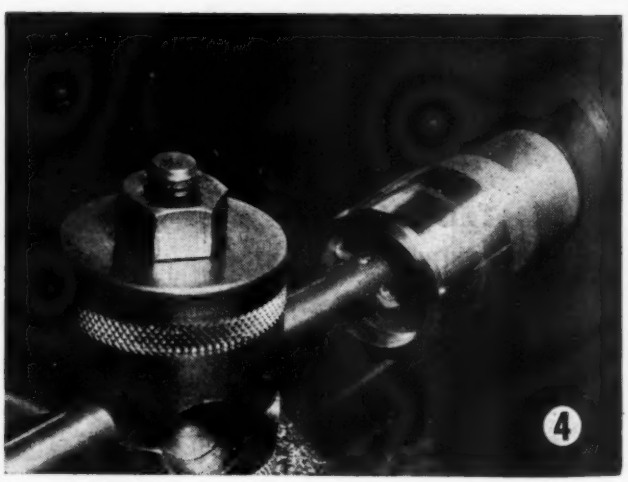
HOW TO MAKE BUSHINGS OF SPRAYED METAL

FREQUENTLY bearing brackets that wear on their inside diameter (those not originally fitted with a bushing) can be bored and a bushing pressed in. This applies generally to inside diameters of 3 in. or less, which are difficult or impossible to build up with a spray gun extension. Anything over 3 in. can be built up directly.

A part originally fitted with a bushing may, of course, be easily restored to service by removing the old bushing and installing a new one provided the new part is on hand or readily available. But more often than not considerable delay is involved in obtaining either a new bushing or the stock from which to make one. Here is a simple and quick way to make bushings to fill practically any need. *Courtesy of the Metallizing Engineering Co, Inc.*







1 Select a piece of brass or steel pipe with an outside diameter 1/32 to 1/16 in. less than the inside diameter of the bushing required. Sandblast the outer surface lightly or cut a fine thread (50 to 60 threads per in.) on it. Then wrap a layer of insulation around one end and clamp it in a lathe chuck. Set up and adjust the spray gun for the wire to be used so that spraying can be started quickly. For a 2-metal job have second wire handy. Heat the pipe to about 500 F, or where steel changes to a brown or purple color.

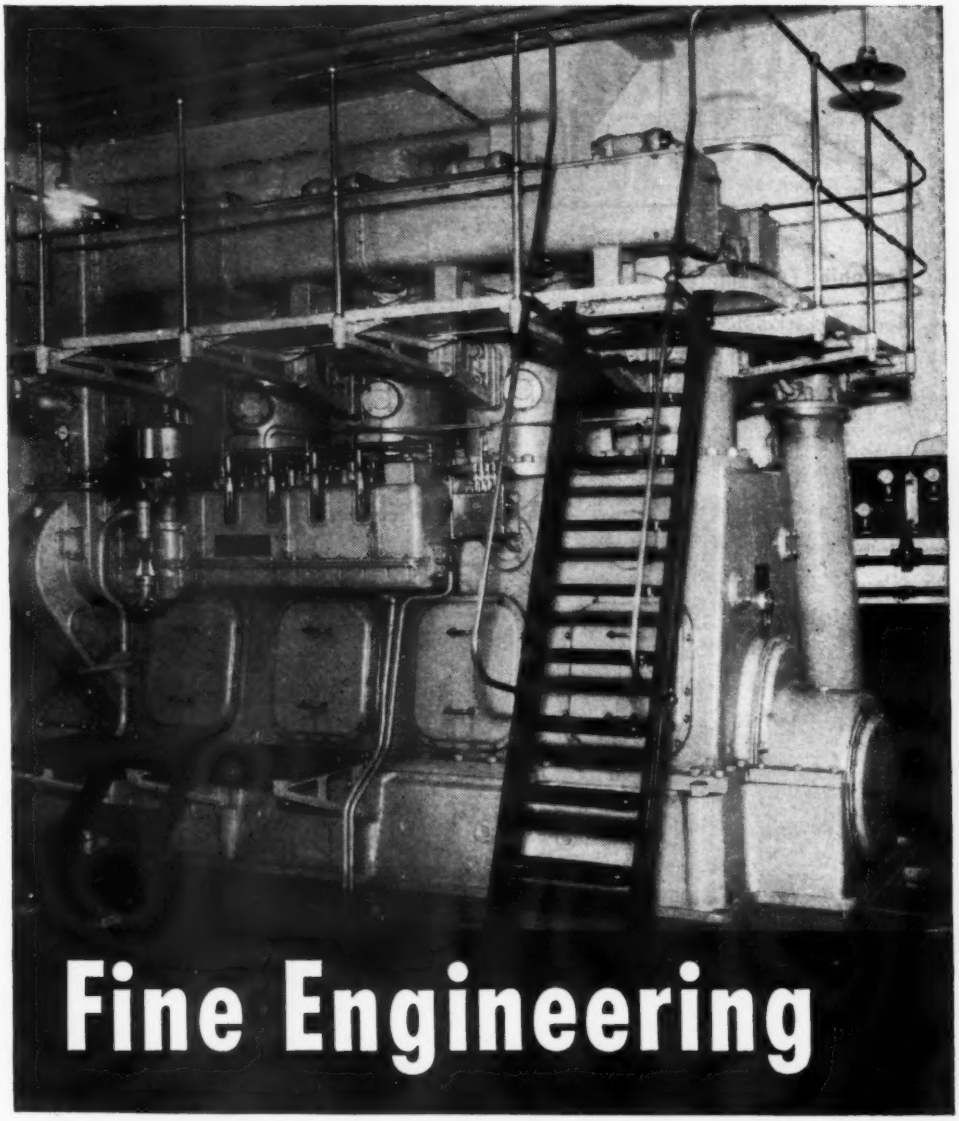
2 Start spraying immediately and continue until the metal is built up to required thickness. Hold spray gun in your hand, traverse the work rapidly and feed the wire as fast as possible, without producing too coarse a spray. Do not stop spraying until job is completed because high temperature may cause oxidation and layer separation.

3 Allow the work to cool, turn down to rough outside diameter and drill the necessary oil holes. After bushing gets perfectly cool make finish cut on outside diameter, allowing for a press fit in housing.

4 Partly finished bushing can then be pressed in place and the pipe bored out, or the inside machining completed in the lathe. Soaking the bushing in oil before pressing helps prevent galling.

Note: Preheating expands the pipe, which minimizes internal stresses in the sprayed metal after cooling and improves the deposit's physical properties so that a good finish is obtained.

Every Baldwin Diesel rests on a Foundation of Fine Engineering



What a municipal power plant needs most in a diesel engine is dependability.

Baldwin Diesels are engineered and manufactured with that thought in mind. Every proven new development that can contribute to complete dependability, high efficiency, and continuous trouble-free service has been included. One important modern feature is the chrome-plated liner, which multiplies liner life many times, and eliminates ring difficulties.

When you are modernizing or expanding your installation, let us tell you what Baldwin Diesels can offer in the way of plant economy and improved performance.

The Baldwin Locomotive Works, Locomotive & Ordnance Division, Philadelphia 42, Pa. Offices: Philadelphia, Chicago, St. Louis, Washington, New York, Boston, San Francisco, Houston, Cleveland, Detroit, Pittsburgh.

BALDWIN PRODUCTS

Locomotives, Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Ship propellers, Marine steering gear, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

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BALDWIN

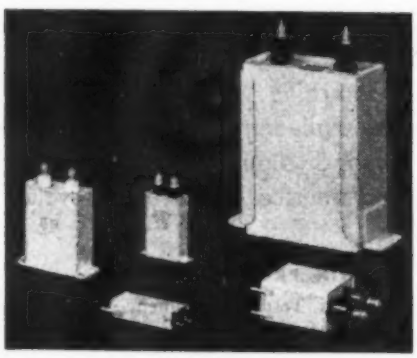
DIESEL ENGINES

What's New in Plant Equipment

Portable Tachometer

MODEL 5-E ELECTRIC TACHOMETER indicates speed or motion of a revolving or moving object by merely applying rubber-tipped shaft to the work. Speed is instantly indi-

cated in rpm on a scale over 3 in. long. Through a unique arrangement, any vibration transmitted through shaft does not interfere with accurate reading of the indicator. There is no internal gearing. Simply press side button to change ranges. Tachometer can be furnished with wheel for measuring surface speeds. *Chicago Electric Tachometer Co, 800 N Clark St, Chicago 10, Ill.*

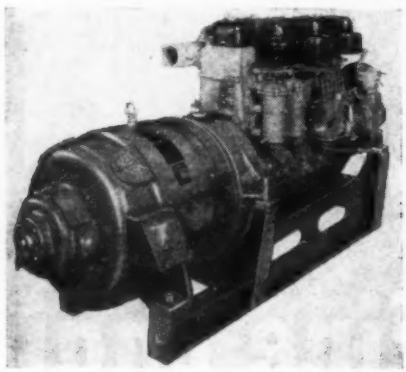


Paper-Dielectric Capacitors

NEW LINE of fixed paper-dielectric capacitors is designed in accordance with proposed joint Army-Navy Specification JAN-C-25. These units are available in case style CP-70, characteristics E and F, for dc applications.

There are 268 standard ratings in the CP-70 class, ranging from 0.1 to 15 microfarad, for circuit voltages from 600 to 12,500 v. All ratings have a capacitance tolerance of ±10%. Standard units vary in size and weight from small units weighing only 3 oz, to large high-voltage units weighing up to 50 lb.

Metallic, rectangular cases are of hermetically sealed construction, with bushings brought out through the top. Bushings with solder-lug B terminals are made of molded *Textolite*, and the pillar-insulator E and D terminals are of glazed wet-process porcelain. All capacitors can be provided with removable mounting brackets of either the footed or screw-spade-lug design, which permit them to be mounted in either an upright or inverted position. *General Electric Co, Schenectady 5, N. Y.*



Generating Set

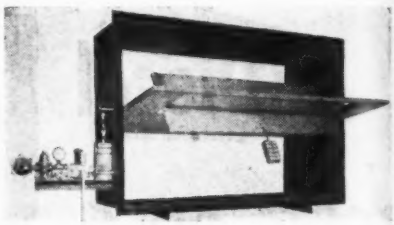
MODEL DA40-N12 DIESEL-ELECTRIC ac generating set consists of a Bardco 40 kw, 120-208 v 3-phase 60-cycle generator, close-coupled and driven by a Superior 6-cylinder diesel engine equipped with a heat-exchanger system. It is for continuous duty in marine, industrial or farm applications for ac or dc current. It is available with complete controls, switchboard and voltage regulator. *Bardco Mfg & Sales Co, Los Angeles, Calif.*

Bulk-Material Conveyor

SIDEKAR-KARRIER handles bulk materials in a horizontal run-around path, within minimum headroom. *Karrier* provides conveyor storage for materials that are to discharge simultaneously in varying quantities at a number of points. Any surplus material that is still left in the conveyor buckets after they have served the several discharge points will remain in the buckets to be recirculated.

Conveyor is both self feeding from any one of many feed spouts, which may be located above its horizontal run-around path of travel, and self discharging to any number of points, thus permitting continuous automatic operation. Material is carried in buckets supported on rollers, rather than being dragged by flights in a trough. Design is such that two or more materials can be fed separately to the conveyor with assurance that the admixture will not be disturbed in transit and that it will be delivered to any predetermined discharge point in exactly the same mixed proportions as prevailed at feed points.

Sidekar-Karrier is available in two designs. Type 1 is for boilerhouse applications, where coal is kept in bunker storage and delivered to one or more scale hoppers, as in cases where each boiler is fitted with individual weigh scales. Type 2 *Karrier* handles capacities up to 100 tons per hr and is ideal where it is important that material does not become degraded or segregated. Both designs handle other bulk materials besides coal. *Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.*



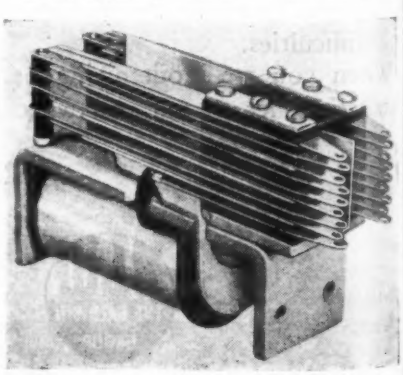
Damper Smoke Control

STACKMASTER DOUBLE-DAMPER smoke control, in sizes to accommodate various smoke stacks, adjusts a smoke stack to daily weather conditions to eliminate excess smoke, reduce excess stack temperatures, maintain uniform draft volume and stop combustion fuel losses. The *Stackmaster*, according to maker, saves from 5 to 50% in fuel cost. It is installed with electric-hydraulic- or pneumatic-control system so that it meets practically all conditions where there are excess smoke and combustion losses. *Campbell Engrg Co, Appleton, Wis.*

Multi-Contact Relay

LONG-COIL TYPE 20,000 RELAY is especially applicable to signal, electronic and communication fields, where minimum operating currents are important factors. Contact spring assemblies may be furnished in one, two or three stacks with various combinations up to 16 springs, according to circuit requirements.

Coils, specially treated to withstand ex-



Tested Ashore for Service at Sea...

Carrier type "9-J" condenser, equipped with Anaconda Cupro Nickel Condenser Tubes and Tube Sheets, and outside shell of Brass.

MEETING A "force test" of 400 lb. per sq. in. air pressure while immersed in water is a preliminary requirement for this type "9-J" refrigerating condenser. Pressure is then lowered to 250 lb. per sq. in. and the unit closely inspected for leaks.

Ability to meet this rigid test is assured in two ways . . . sound construction by the manufacturer, Carrier Corporation of Syracuse, N. Y., and the use of tough, corrosion-resistant Anaconda Alloys. Tubes and tube sheets are made of Cupro Nickel, and the outside shell is Brass.

In addition to service in LST's, the Carrier type "9-J" Condenser, with modified head plate, is also used in DE vessels.

For heat transfer service in the marine, power, petroleum, process and other fields, The American Brass Company manufactures a wide variety of Anaconda Copper and Copper Alloys in sheets, tubes and other forms. Equipment fabricators are invited to utilize the broad experience and metallurgical knowledge of our Technical Department in determining the most suitable alloys.

45127

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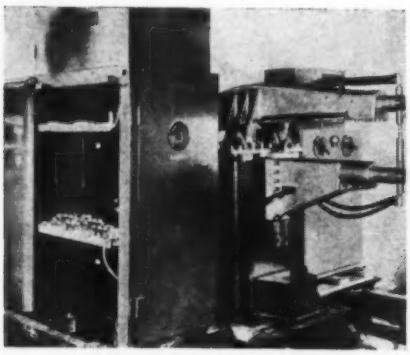
Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

EQUIPMENT *Continued*

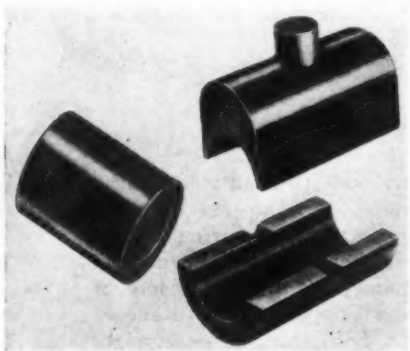
treme humidity and prevent fungus growth, are in voltage ranges from 1½ to 28 v dc. This relay is also in 2-pole double-throw contact arrangement, with current sensitive coil operating at 3.2 milliamps pickup and 1 to 1.5 milliamps dropout. These relays are available with quick-acting slow-dropout and slow-pickup armatures.

Type 20,000 relays are produced in two sizes, both depending upon contact spring assembly: standard—4¾ in. long, 1 in. wide and about 1¾ to 2½ in. high; intermediate —3⅜ in. long, 1 in. wide and 1¾ to 2½ in. high. *R-B-M Mfg Co, Logansport, Ind.*



Resistance Welders

RANGE OF COMMERCIALLY PRACTICAL storage-battery-powered resistance welders now available includes spot, roll-spot and projection in both rocker arm and pedestal models. Design is such that the battery is an integral part of machine for small- and medium-power capacity and separate power packs house the batteries for higher power requirements. Models for 6, 12, 16 and 30 cells have been standardized, the 6, 12 and 16 cell models being integral with the welder. *Progressive Welder Co, Detroit, Mich.*



Self-Lubricating Bearings

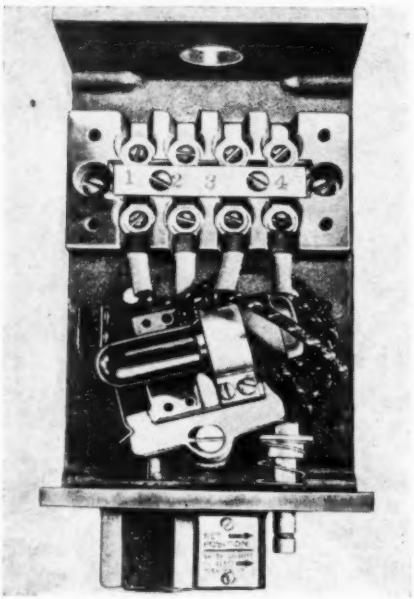
MORGANITE SELF-LUBRICATING bearings are available in compositions of carbon, graphite, or both. If necessary, they are also supplied with various metallic contents for special applications. They have low coefficients of friction and expansion. Wear is said to be negligible on bearings as well as on contacting surfaces.

In operation, bearings glaze cooperating surfaces with a protective coating. They impart no odor or taste to liquids. Morganite bearings are readily machineable, but may be molded with tolerances to .001 in. Outside diameter of ⅛ to 15 in. is permissible. They may be supplied in any shape, with any contour required. Operating speeds to 50,000 rpm with thrust loads to 30 psi, or loads to 2000 psi at slower speeds, are possible. *Morganite Brush Co, Long Island City 1, N. Y.*

Absorbent Material

SUPER-ABSORBIT is a highly absorbent mineral used on surfaces where oil, grease, water, sirup, chemical, etc, are spilled. It is also employed for acid absorption. It does not become slippery or mat when saturated and is always sweepable.

Super-Absorbit absorbs 392.8% of its weight in water and 315.62% in oil. It is fireproof, dielectric, lightweight and contains a minimum amount of abrasive. *Alexite Engineering Co, Alexander Film Bldg, Colorado Springs, Colo.*



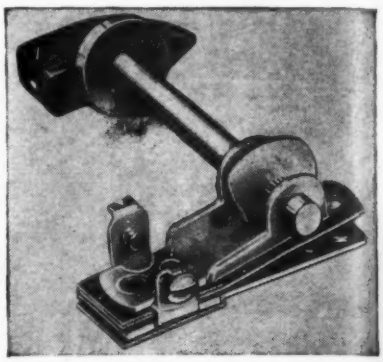
Pressure Switch

KIDDE PRESSURE SWITCH is an accessory device for built-in carbon-dioxide fire-extinguishing systems. When extinguishing system operates, switch assists in isolating fire by automatically cutting off electrical circuits in fans, blowers or other electrical equipment. It is a self-contained mercury contact switch, suitable for applications that employ gas or air pressure.

Pressure switch, connected by a bleed pipe from the main distribution line, is operated by the carbon dioxide passing through this distributing piping to discharge nozzles. Gas pressure actuates a plunger, which trips breaker arm of switch, opening or closing the circuits desired. Device is available for control of two, three or four circuits, each of which may be wired for normally open or closed operation. Pressure switch has a manual reset to restore circuits to their original position after operation. *Walter Kidde & Co, 140 Cedar St, New York 6, N. Y.*

Thermostatic Switch

COMPACT UNIT, rated at 1500 watts, 115-230 v, ac, may serve as either, or both, a thermostat and a manual switch. It eliminates the necessity of an additional on-and-off switch and permits instant adjustment of



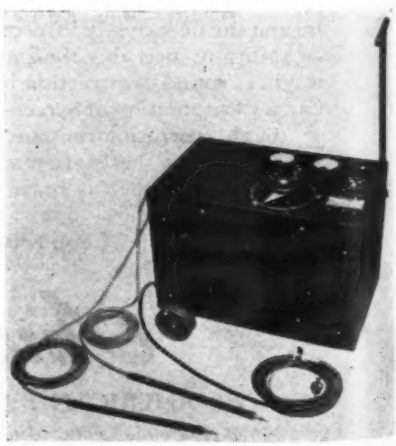
thermostat. Ideally suited for mounting on bottom of electrically heated equipment where manual on-and-off knob is desired, it is simple and foolproof in operation. Knob can be located any distance from thermostatic element by lengthening cam shaft. Pointer on knob may be set at any desired temperature; thermostat controls heating element. Temperature can be increased, decreased or shut off by merely turning knob. Unit is available in three adjustable temperature brackets: 50 to 300 F, 50 to 450 F and 50 to 700 F. *George Ulanet Co, 88 E. Kinney St, Newark, N. J.*

Test Sets

TWO PORTABLE AC TEST SETS, capable of supplying smooth test voltages from 0 to maximum voltages (2000 and 6000 v) operate from any 115-v 50- or 60-cycle outlet and have a capacity of 2000 va. Units were developed especially for testing diesel-electric locomotives larger than 600 hp, but have many industrial testing applications, such as generators, motors, motor parts and appliances.

Both sets consist of a dry step-up transformer, variable-voltage autotransformer, two indicating voltmeters, voltmeter selector switch, signal lamp, air circuit breaker with magnetic overload trip and a supply switch. Two 15-ft shielded test leads with insulated

(*Continued on page* 164)

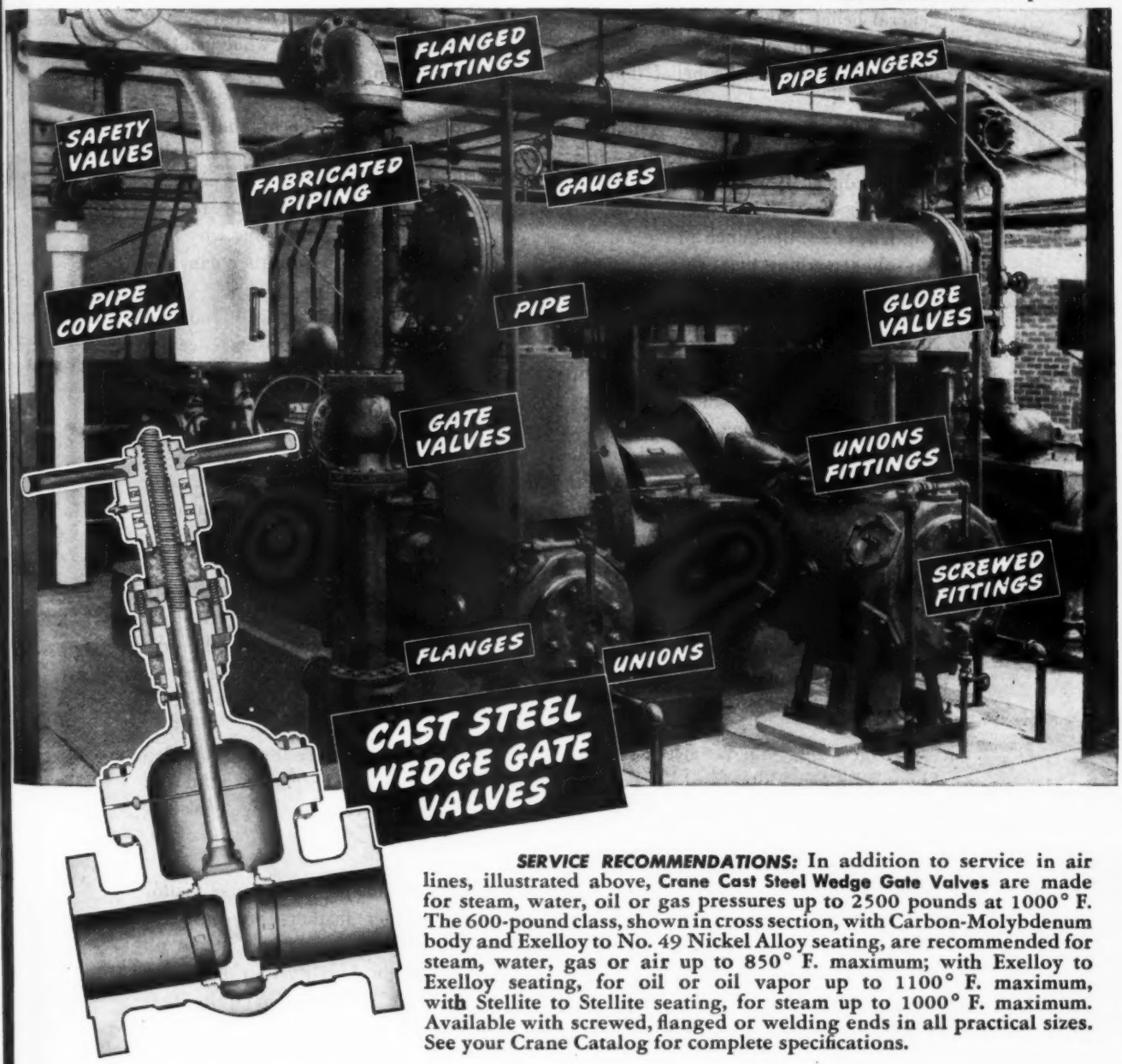


Wherever You Need Piping Materials
...RELY ON CRANE

ONE SOURCE OF SUPPLY • ONE RESPONSIBILITY • ONE STANDARD OF QUALITY

Supplying everything necessary for any piping system is the job of your Crane Branch or Wholesaler. This single source offers the world's greatest selection of piping materials—in brass, iron and steel. Uniform quality in all materials—backed by single responsibility—helps assure the best installation. By using Crane *complete* piping materials service, you speed deferred replacements—keep piping performance at its best. Below is an example of the completeness of the Crane line—in Cast Steel Wedge Gate Valves.

Steam-Driven Air Compressor



SERVICE RECOMMENDATIONS: In addition to service in air lines, illustrated above, **Crane Cast Steel Wedge Gate Valves** are made for steam, water, oil or gas pressures up to 2500 pounds at 1000° F. The 600-pound class, shown in cross section, with Carbon-Molybdenum body and Exelloy to No. 49 Nickel Alloy seating, are recommended for steam, water, gas or air up to 850° F. maximum; with Exelloy to Exelloy seating, for oil or oil vapor up to 1100° F. maximum, with Stellite to Stellite seating, for steam up to 1000° F. maximum. Available with screwed, flanged or welding ends in all practical sizes. See your Crane Catalog for complete specifications.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

90 YEARS OF PROGRESS 1855 1945

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

CURIOSITY . . .

Some phrase-maker put together that tart "curiosity killed the cat" years ago—and thereby did a great disservice to his fellow men. If there's anything this world needs, it's healthy curiosity about things and people.

I don't mean the "here's the dope on Hollywood" or peeping-Tom variety of malicious snooping, but a tremendous desire to know what makes things tick. The general belief is that engineers have that kind of desire, but most of us don't. The net result of all our education and training is a set of "rules" about what can't be done and an unfaltering belief that whatever we see in print must be so.

Dr Willis R Whitney, now honorary vice-president of GE, isn't of that stripe. Says he: "When I have a hunch for a scientific experiment, I can find any number of well-educated men who can tell me all kinds of high-powered and perfectly logical reasons why it won't work. It is a pleasure, in the face of their reasons why not, to see the hunch prove out. Some men have thousands of reasons why they can't do something they want to, when all they need is one reason why they can. . ."

So Dr Whitney wonders why not an electrically heated birdhouse—why red ants stripped of their enslaved black ants die while their former slaves prosper—sees in a tumorous swelling on a plant a possible explanation of the cause of cancer—works out a way to make conches inlay a design of his choosing in their shells—uncovers arrowheads by deciding where he, if he were an Indian, would shoot them—discovers his knowledge of chemistry and electricity helps him study neurology—finds in an insect he took out of a broken bough the answer to a cable failure—suggests a pain meter and a disposable dining set—wonders why the youngest turtles he finds around are at least eight years old. . .

His idea is that we all ought to investigate interesting things for the pure "pleasure of doing it, for the good of the soul, and the satisfaction of curiosity." Don't misunderstand—he is thinking of inquiries that bring results, not the idle curiosity that so frequently is a substitute for basic thought. He suggests the real joy in blazing a new trail of ideals, in finding that an accepted answer is wrong.

I suggest that you begin by reading the pamphlet, "Things I've Been Thinking About," by Dr Whitney, which I'm sure General Electric would be glad to send you upon request to Schenectady. It's only about 20 pages of easy reading. Ask for GES-3222.

As for me, I'm going to find out why one red-winged blackbird, a regular visitor to my chicken yard, doesn't have the red-orange shoulder feathers but only the yellow stripe. And I've tied a new red-white-and-blue fly to try on some trout on July 3, 4 and 5. Last year, that violator of tradition was the only fly they'd take on Independence Day. I can't quite believe that trout are patriotic—or quite that calendar-conscious.

George Edwards
Engineer

"A yardstick shows why J-M INSULATING FIREBLOK saves installation time!"

• *One* Johns-Manville insulating Fireblok has more surface area than *five* ordinary fire brick. The saving in installation time is apparent . . . as is the reduction in costly furnace down-time.

The four types of Johns-Manville Insulating Fireblok (lightweight insulating refractory linings in block form) are suitable for the same service and temperature ranges as the four well-known J-M Insulating Fire Brick. The only difference is size . . . an installation of the much larger Fireblok can be completed in much less time than with standard size brick.

In addition to its larger size, J-M Fireblok also has these important advantages:

Easy Cutting and Fitting—can be cut with a saw and shaped with a rasp. Most special shapes can be cut from standard slabs, reducing the inventory of special shapes.

Minimum of Joints—the large size, compared to standard fire brick, materially reduces number and length of joints, resulting in thermally more efficient construction.

Economical Bonding—with reduced joint length, Fireblok requires a minimum of airset cement for bonding. (J-M 1626 Cement was especially developed for this use.)

Uses—use Fireblok wherever insulating Fire Brick is recommended, as for industrial furnaces, flues, stacks, etc. Fireblok is particularly suitable for the lining of doors, for suspended arches, and when tapered, for sprung arches of exceptional stability.

By having J-M FIREBLOK applied by J-M Technical Service Units or Johns-Manville's construction forces you assure a thorough, speedy and economical installation. In this way you get the utmost in insulating efficiency and length of service.

Installing J-M Fireblok on a suspended arch-type furnace, using convenient J-M hanger supports. Despite the large size of Fireblok, it is light in weight . . . easily handled.

4 Types Available:

JM-1620 Fireblok for exposed temp. to 1600°F. As back-up to 2000°F.

JM-20 Fireblok for use up to 2000°F. Exposed or back-up.

JM-23 Fireblok for use up to 2300°F. Exposed or back-up.

JM-26 Fireblok for use up to 2600°F. Exposed or back-up.

Johns-Manville
22 East 40th Street, New York 16, N. Y.

INDUSTRIAL INSULATIONS
for every temperature—for every service

POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

FOREIGN FIELDS • MODERNIZATION • FUEL CONSERVATION

Turbine-Generators Get OWU Approval

Office of War Utilities announces that approval has been given for 430,000 kw of steam turbine-generators to be installed in 1946, 1947 and 1948. About 250,000 kw in additional installations were expected to be approved also.

Installations approved thus far are as follows:

A 15,000-kw unit and a 100,000-lb-per-hr boiler for Richmond, Ind., municipal system.

A 22,500-kw unit and a 123,000-lb-per-hr boiler for South Carolina Power Co at a Charleston station.

A 25,000-kw unit for Ottawa Street Station of Lansing, Mich., municipal system.

A 35,000-kw unit and a 250,000-lb-per-hr boiler for Middletown, Pa., station of Metropolitan Edison Co.

A 7500-kw unit and a 75,000-lb-per-hr boiler for Kirk Station of Sioux City Gas & Electric Co.

A 20,000-kw unit and a 250,000-lb-per-hr boiler for Tulsa Power Station of Public Service Company of Oklahoma.

An 80,000-kw unit and two 375,000-lb-per-hr boilers for Venice plant No. 2 of Union Electric Co of Mo.

An 80,000-kw unit and a 600,000-lb-per-hr boiler for Port Washington plant of Wisconsin Electric Power Co.

A 50,000-kw unit and two 275,000-lb-per-hr boilers for Maredosia plant of Central Illinois Public Service Co.

A 20,000-kw unit and a 250,000-lb-per-hr boiler for El Centro plant of Imperial Irrigation District of California. This unit replaces a hydro plant which the district was refused permission to build at the Pilot Knob site on the All-American Canal.

Two 16,000-hp diesel units complete with auxiliaries and building for Iowa Public Service Co, one to be installed at Storm Lake and the other at Ida Grove, Iowa.

A 37,500-kw unit and a 400,000-lb-per-hr boiler for West Junction plant of Houston Lighting & Power Co.

A 37,500-kw unit and a 350,000-lb-per-hr boiler for New Orleans Public Service Co's Gentilly plant.

A 70,000-lb-per-hr boiler and a boiler house for Peru, Ind., municipal system.

A 35,000-kw unit for Grand Ave plant of Kansas City Power & Light Co in Kansas City.

A 7500-kw unit and a 90,000-lb-per-hr boiler for Louisiana Ice & Electric Co, St. Landry, La.

A 65,000-kw steam turbine and a 570,000-lb-per-hr boiler for Harbor steam plant of Los Angeles Dept of Water & Power. An auxiliary 4000-kw steam turbine for the same plant also was approved. The new machine is to go into operation in 1947.

A 34,000-kw unit and a 300,000-lb-per-hr boiler for suburban plant of Scranton Electric Co.

A 22,500-kw unit with a 230,000-lb-per-hr boiler for the Eaton plant, near Hattiesburg, of Mississippi Power Co.

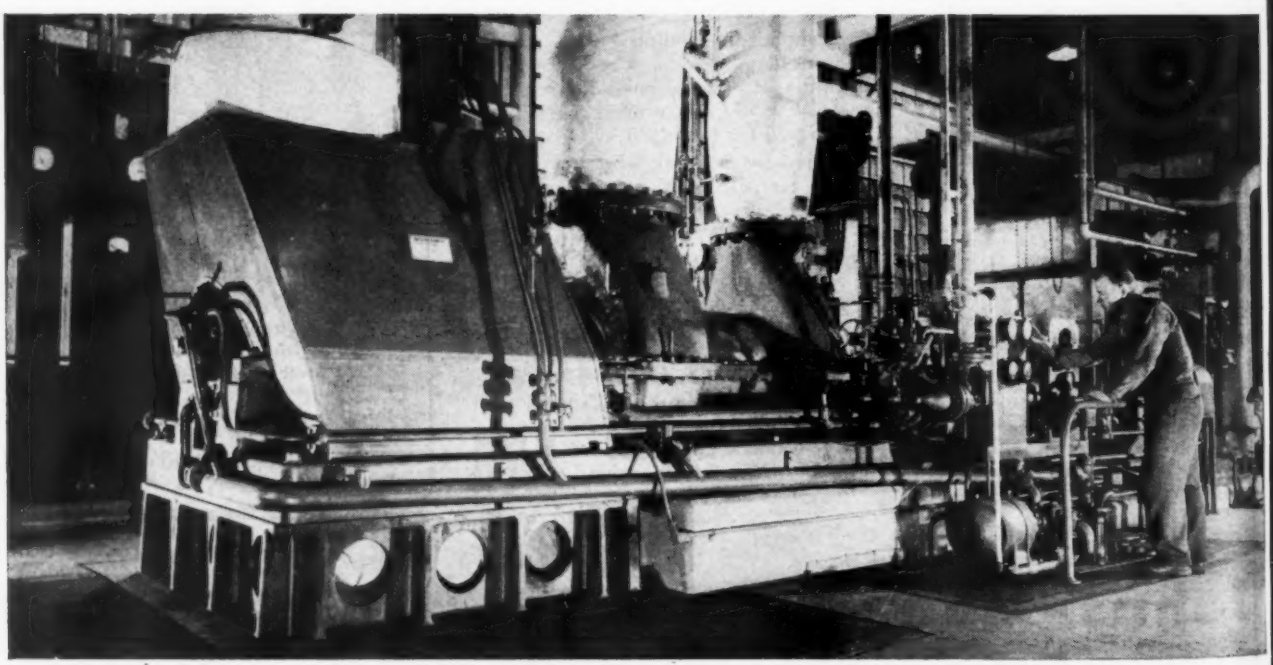
A 35,000-kw condensing unit and a 410,000-lb-per-hr boiler for Long Island Lighting Co.

A 25,000-kw unit and a 35,000-lb-per-hr boiler for East Palestine, Ohio.

A 20,000-kw unit and a 20,000-lb-per-

(*Continued on page* 190)

GAS TURBINE SERVES IN REFINERY



This gas turbine and a companion unit are producing 10,255 hp in a 100-octane gasoline plant in Ohio. It is one of 29 Allis-Chalmers' gas turbines now performing successfully in the Houdry process for oil-refinery service

here is a thought on the subject of WATER TREATMENT...

(. . . for those who sit in the front office)

"Water treatment is a scientific subject through and through and should be treated as such. Industry can obtain *maximum* benefits from water treatment *only* when the formulae and administration of water-treating chemicals are placed in the hands of a company that looks on water treatment through the eyes of a scientist.

The men in your plant, your operating engineer or master mechanic, who see *first hand* how scale, corrosion, foaming and algae can lower the efficiency and production in your plant—the recommendations of these men should be management's guide in selecting the company entrusted to solve its water treatment problems."

Photo in Nalco Laboratories

Says

Bob Moran

Nalco Representative, New England

THE SYSTEM OF SCIENTIFIC WATER TREATMENT

Nalco

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • **Chicago 38, Illinois**

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ontario

How to plan a CLOSED COOLING WATER SYSTEM

Second of a series of basic Piping Layouts to appear each month in these pages. Watch for them.

Cooling towers are frequently employed to reduce the expense of city water for installations using cooling water, such as air conditioning units, refrigerating systems, and Diesel plants. Many local building codes prohibit the use of water for cooling purposes unless a system is installed which provides the continuous reuse of the water.

A typical installation is shown in this layout for cities or industrial areas where the atmosphere is laden with corrosive vapors and other products of combustion. To avoid the absorption of these vapors into the cooling water circuit, a closed system is used. The tower water never comes in contact with the equipment itself, but reduces the temperature of the cooling water, in its closed system, through a heat exchanger. Pumps are shown in duplicate to guarantee continuous operation in case of a breakdown to the main system.

Bronze valves are recommended for the closed cooling water system and the city water connection. Iron valves are advisable for the tower water lines because of the presence of sulphur acids or other destructive media in the water.

Many types and pressure ranges of Jenkins Valves, other than those listed here, are suitable for a Closed Cooling Water System, according to the nature of the installation. Jenkins recommends consultation with accredited piping engineers and contractors, either when adapting these suggestions to your own requirements, or when planning any major piping installations.

Send the coupon below for copies of this and future Piping Layouts as they appear.

Jenkins **PRACTICAL PIPING LAYOUTS**

2

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

1. **Place valves correctly in the line.**
2. **Use the right type valve for the service.**
3. **Choose Jenkins Valves for lifetime economy.**

OVER 600 VALVES TO CHOOSE FROM

Whatever types of valves your plans call for, you can find them, with few exceptions, in the Jenkins Catalog. This complete line includes over 600 different patterns, designed by Jenkins Valve specialists for commercial, industrial, engineering, marine, and plumbing-heating services – in bronze, iron, air furnace malleable iron, steel, and corrosion-resisting alloys. To save time – to simplify planning – to make sure of the lowest cost in the long run – select all the valves you need from the Jenkins catalog.

Jenkins Bros., 80 White Street, New York 13: Bridgeport: Atlanta; Boston; Philadelphia; Chicago; San Francisco. Jenkins Bros., Ltd., Montreal: London, England.

JENKINS BROS., 80 White St., New York 13, N. Y.

Please send me a copy of this, and future PRACTICAL PIPING LAYOUTS, as they appear.

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Company.....

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Since 1864 **JENKINS**

CODE	QUANTITY	JENKINS VALVES	SERVICE
A	1	FIG. 106A—BRONZE GLOBE	BY-PASS CITY WATER MAKE-UP TO COOLING TOWER
B	2	FIG. 106A—BRONZE GLOBE	COOLING WATER DISCHARGE PUMP
C	1	FIG. 108A—BRONZE ANGLE	DRAIN CITY WATER MAKE-UP LINE
D	3	FIG. 76 DA*—IRON GLOBE	COOLING TOWER CIRCULATING PUMP AND TOWER DRAIN
E	2	FIG. 77 DA**—IRON ANGLE	3-WAY MODULATING VALVE BY-PASS CONTROL
F	8	FIG. 368 O.S.&Y.—BR. GATE FIG. 47 T.S.—BR. GATE	COOLING WATER LINES
G	2	FIG. 98—IRON GATE	COOLING TOWER SHUT-OFF
H	5	FIG. 100—IRON GATE	COOLING TOWER WATER LINES
J	2	FIG. 352—BRONZE CHECK	COOLING WATER PUMP CHECK
K	3	FIG. 624—IRON CHECK	COOLING TOWER PUMP CHECK

ALVES

BRONZE • IRON • STEEL

FOR EVERY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING-HEATING SERVICE

Sold Through Reliable Industrial Distributors Everywhere

TRADE JENKINS MARK

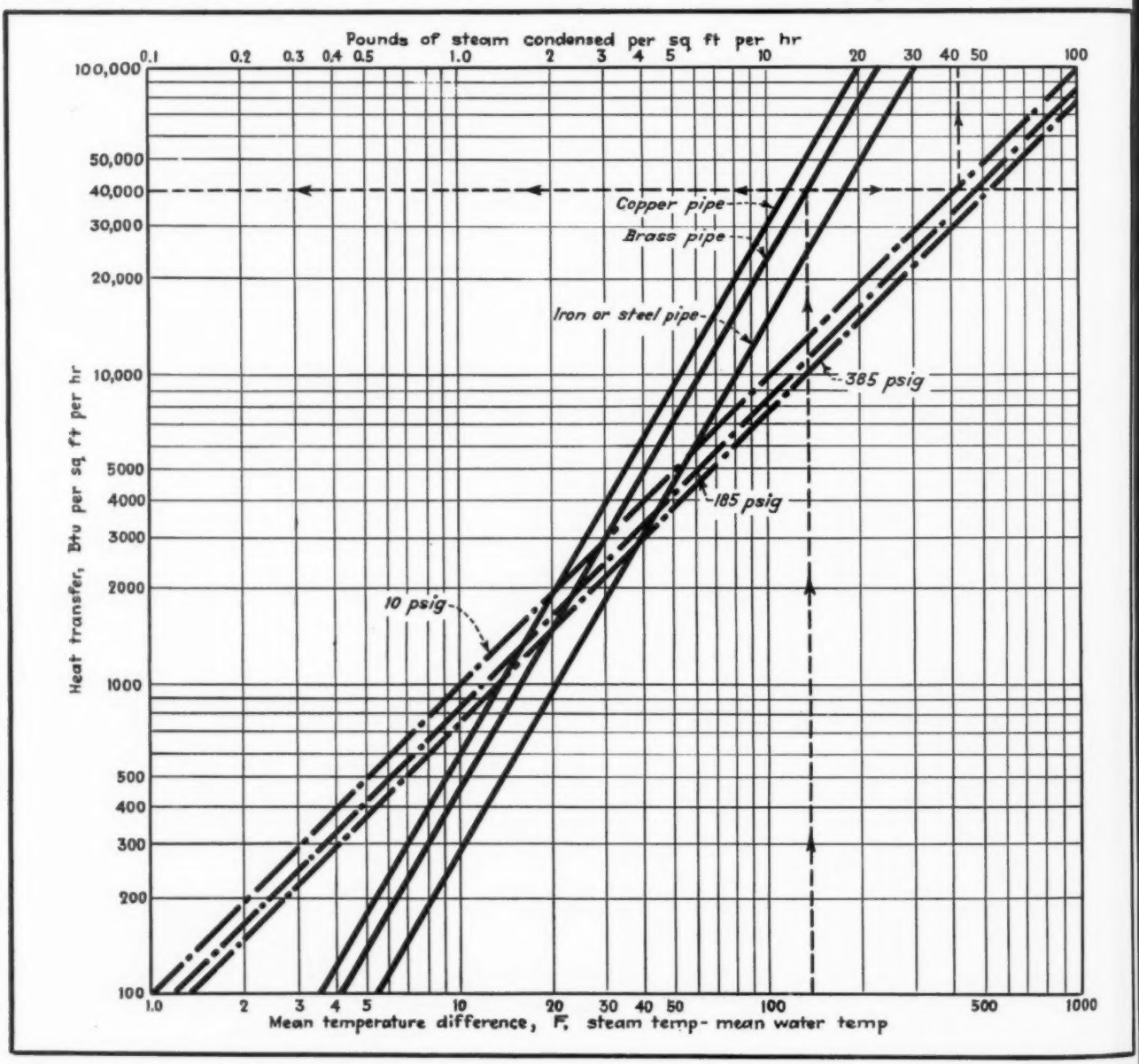
Jenkins Bros

Number 155

Water Heating by Tank Coils

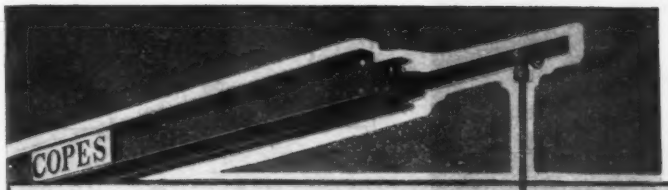
► APPROXIMATE LENGTH of submerged steam pipe coil needed to heat water can be quickly calculated with the aid of this chart. Values for brass and iron pipe are based on American Radiator and Standard Sanitary Corp test data. Size of trap should be twice that of steam condensation given by chart.

Example: How many Btu per hr and lb per hr of steam will be condensed in a 2-in. brass pipe coil in heating water from 40 to 170 F, using 10 psig steam? Temperature of steam from steam tables is 240 F. Mean water temperature is 40 + 170 ÷ 2 = 105 F. Temperature difference between water and steam is 240 − 105 = 135 F. Follow upward from base scale to line for brass pipe and read 40,000 Btu per hr per sq ft of pipe at left. At right, follow horizontally to 10-psig line and upward to 42 lb per hr of steam per sq ft of pipe. Since it requires 1.608 linear ft of 2-in. standard pipe to provide one sq ft of outside surface (from pipe tables, calculated, or Power Data Sheet No. 12) each linear ft of coil will transfer 40,000 ÷ 1.608 = 25,000 Btu per hr and will condense 42 ÷ 1.608 = 26 lb of steam per hr.

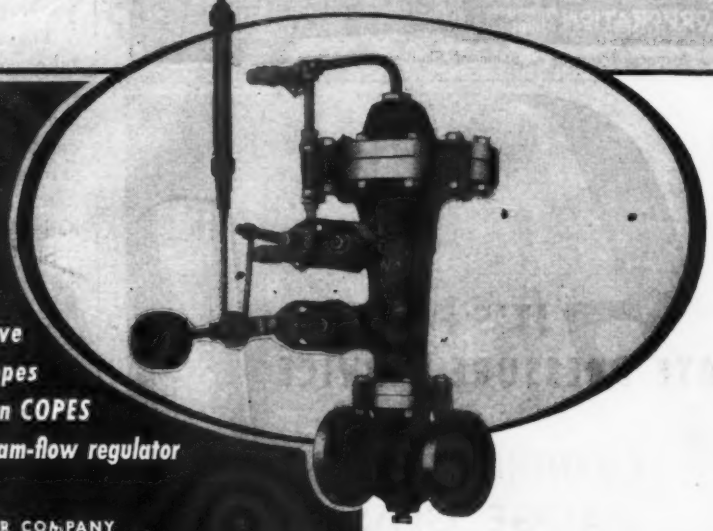


Courtesy Crane Co.

© POWER



PAY ONLY FOR MODERNIZATION
CONVERT TO FLOWMATIC



Just a few companies who have converted older Copes Regulators to modern COPES Flowmatic—the steam-flow regulator

BARRETT COMPANY
BLANDIN PAPER COMPANY
DETROIT EDISON COMPANY
EASTMAN KODAK COMPANY
GARDNER-RICHARDSON COMPANY
STATE UNIVERSITY OF IOWA
JERSEY CENTRAL POWER & LIGHT COMPANY
JONES & LAUGHLIN STEEL COMPANY
NATIONAL CONTAINER CORPORATION
NEBRASKA POWER COMPANY
OTTER TAIL POWER COMPANY
PUBLIC SERVICE COMPANY OF COLORADO
PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS
PUBLIC SERVICE ELECTRIC & GAS COMPANY
REPUBLIC STEEL CORPORATION
SCOTT PAPER COMPANY
WHEELING STEEL CORPORATION
YOUNGSTOWN SHEET & TUBE COMPANY
DEWEY PORTLAND CEMENT COMPANY
TENNESSEE EASTMAN CORPORATION
SHELL OIL COMPANY, INC.

THE cost of converting COPES Simple Level Regulators to Flowmatic, the 2-Element Regulator, has been kept to a minimum through sound basic design. As specialists in boiler feed water systems, it is our aim to make improvements readily adaptable to our thousands of COPES users.

The plants noted at the left are a few that have recently converted to Flowmatic—they paid only for the additional parts and service required.

The simple, sturdy, dependable COPES Regulator can either be made like new again or can be converted into a more modern type COPES unit. The scrap drive will never catch a COPES. If you are an old COPES user you will want to know how to convert to COPES Flowmatic. Write for booklet 429 that tells about Flowmatic, then we can talk about application or conversion.

NORTHERN EQUIPMENT CO • 751 Grove Drive, Erie, Pa.
FEED WATER REGULATORS • PUMP GOVERNORS • DIFFERENTIAL VALVES
LIQUID LEVEL CONTROLS • REDUCING VALVES AND DESUPERHEATERS
BRANCH PLANTS IN CANADA, ENGLAND REPRESENTATIVES EVERYWHERE

FOR *High Duty* BOILERS

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

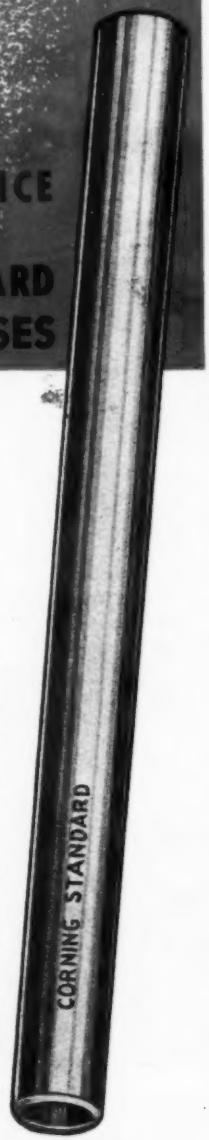
KEWANEE
SCOTTIE JR BOILER
5 sizes for small industrial usage. 9.9 to 30 H.P. Conveniently compact, yet easily accessible. Low in cost—economical to operate.
75 Years Boilermakers
For 6" scale with pipe diameter marking, write Department 99-K-7
KEWANEE BOILER CORPORATION Kewanee, Illinois
Division of American Radiator & Standard Sanitary Corporation

if IT'S FOR MODERATE PRESSURE SERVICE use CORNING STANDARD GAUGE GLASSES

These Gauge Glasses are sturdy enough to give you long-lasting service where pressures are not excessively high. Crystal clearness makes reading easy throughout a long service life. Machine drawn accuracy of CORNING Standard Gauge Glasses makes installation simple without manipulation and without the installation strains that tend to shorten the life of gauge glasses.

For high pressure duty or for locations where visibility is poor select the proper PYREX Gauge Glass for those service conditions from the complete PYREX Line. There is an economical, serviceable PYREX or CORNING Gauge Glass to meet your specific needs.

A complete line to solve your particular gauge glass needs.



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CORNING Glass Works Corning, New York
Corning Gauge Glasses

Multi-Stage Ejectors

(*Continued from page* 79)

excessive system pressure for the first stage. These breaks are also a function of intercondenser performance and vary with condensate quantity and temperature. A series of plots like Fig. 5 should be made for the range of condensate temperature and quantity expected.

These tests offer some difficulty and take considerable time. For example, it took three weeks to establish all combinations of four condensate flows, three condensate temperatures and three air-saturation temperatures. Nearly 5000 items of observed and calculated data had to be entered.

Standard "subcooling" performance curves are obtained from plots similar to Fig. 5. It is assumed that vapor temperature to ejector inlet is some constant amount above saturation temperature at the observed pressure, usually 7½ F, and a suction-pressure air-capacity curve plotted as in Fig. 6. Such curves are often requested by operators but it should be pointed out that the data has only limited uses for checking actual operation. The subcooling curves have all the limitations of the plot of Fig. 5 and in addition limit subcooling to one value. Actual subcooling will range from 3 to 25 F.

Some attempts have been made to test complete ejector units with loads of measured air and steam. Since it is difficult to reduce steam temperature to required low values such tests have proved unreliable. It takes considerably more energy to compress superheated vapor than saturated, a condition which leads to error.

Three-stage ejectors offer somewhat better economy at very low pressures and are frequently specified for suction pressures below 1-in. Hg. Surface-type intercondensers are used between stages and an aftercondenser is usual. System pressure of the third stage is atmospheric plus aftercondenser and vent-pipe friction, substantially constant. System pressure of the second stage depends on performance of the third stage and second intercondenser. Correspondingly, system pressure of the first stage depends on performance of the second stage and first intercondenser. Analysis of performance of the over-all unit follows the same procedure as for 2-stage ejectors and the curves required differ in no important respect from the illustrative plots shown.

With specific curves for an actual ejector unit it is a relatively simple

Threads Won't Stick or Freeze on the CHAPMAN List 960

PATENT
No. 1,866,292

THE Chapman List 960 has quick-acting threads for fast opening and closing—they won't stick or freeze. Full pressure packing prevents transmission of pressure to the stem. Seats and plugs can be superhardened for extra severe services.

Chapman List 960 valves in sizes from ¼" to 2"—carbon steel for pressures to 800 pounds; alloy steel for pressures to 1,000 pounds at 750° F. For higher pressures, specify List 990.

The Chapman Valve
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.

A Better STRAINER

- Cadmium Plated Inside and Out
- High-Grade Woven Monel Wire Screen
- Readily Removed Steel Blow-Off Bushing
- Screen and Bushing Come Out Together—Go Back Together, Automatically Aligning
- For Steam Lines or Water, Oil and Other Fluids
- Reasonably Priced
- 6 Sizes from ½" to 2" for Pressures up to 600 lbs
- Many Thousands in Service
- Sold by Over 100 Mill Supply Houses

See Your Supply House or Send for Bulletin S-200

YARNALL-WARING COMPANY
100 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

matter for an operator to check the condensable and non-condensable components of the vapor being removed from a condenser. If such check becomes a matter of routine, it offers forewarning of trouble in the condenser as well as of the ejector itself. It is also possible to tell what effect changing system pressures have on ejector performance and take advantage of steam savings by adjustment of motive-steam pressure. The most important consideration, however, is assurance that the ejector is functioning as well as it can in holding best possible condenser vacuum.

Pumps Q & A

(*Continued from page* 116)

bases or sole plates and building up the foundation to various heights as required for the different parts of the equipment.

Q 15—*When must the pump and the bedplate construction be made to give centerline support?*

A—When liquid temperatures are high it is necessary to support the pump casing as nearly as possible to its horizontal center line, Fig. 7, to prevent temperature differences from seriously disturbing the unit's alignment and eventually damaging the pumping equipment. This construction is generally employed for refinery pumps handling high-temperature hydro-carbons and for heater-drain and boiler-feed pumps operating at temperatures of 300 F and higher. Some pump manufacturers provide centerline support for all boiler-feed centrifugal pumps regardless of operating temperature.

Q 16—*What is meant by pump setting?*

A—It means the distance from the supporting floor to the suction-bell mouth or flange of vertical pumps, particularly those suspended in wet pits or in wells. This term is also used in a less definite manner with vertical dry-pit pumps where it refers to the distance from the floor supporting the driver to either the floor supporting the pump or the suction opening on the pump.

Q 17—*What is a pump bowl?*

A—In deepwell turbine-pump practice, the bowl is the stationary part containing the diffusion vanes, Fig. 8.

Q 18—*What is a pump-bowl assembly?*

A—Pump-bowl assembly, working barrel and pumping element, are all used interchangeably to mean the assembly of all impellers and pump

TUBE-TURN

TRADE MARK

WELDING FITTINGS AND FLANGES

TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge	
						Nominal Pipe Size	Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-12"	1"-8"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"*	¾"-30"*	1"-12"	1"-8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-12"	3"-8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	¾"-24"	¾"-24"	1"-12"	1"-8"		
Tees	Reducing Outlet	¾"-24"	¾"-24"	¾"-12"	1"-8"		
Reducers	Concentric & Eccentric	1x⅜-24x20	1x⅜-24x20		1x⅜-12x10		
Caps		1"-24"	1"-24"		1"-8"		
Stub Ends	Lap Joint	1"-24"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"**					
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing-on-Run	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24"**					

SUPER Tube-Turn 45° long radius elbows, 90° long radius elbows, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12". Tube-Turn welding fittings and flanges conform to applicable ASA and ASTM Standards. For further details please refer to Tube Turns catalog and data book No. 111.

*30° size short radius.

**Since saddles and sleeves are used for external reinforcement only, they do not conform to iron pipe size thicknesses.

TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Socket Type	¼"-24"	¼"- 4"		¼"-3½"			
Reducing-threaded or slip-on	¾"-24"	¾"-24"	¾"-24"†	¾"-24"	¾"-24"*	¾"-24"	¾"-12"
Orifice—threaded		1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—slip-on		1"-24"					
Orifice—welding neck		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Long Welding Neck	1"-24"	1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	

†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

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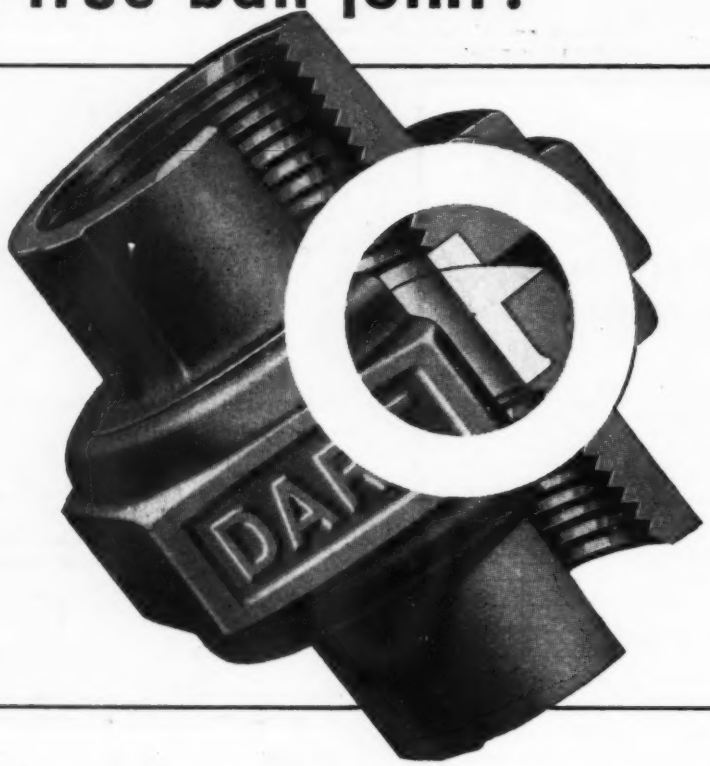

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bowls, together with their rings and bearings and that section of the shafting on which the impellers are mounted in a deepwell pump, Fig. 8.

Q 19—*What is a discharge column?*

A—Discharge column in a deep-well turbine pump is the pipe and complete shafting between pump bowl assembly and the pump head. It acts both as the supporting column for the pump-bowl assembly and as a pipe to carry the water to where it is discharged, Fig. 8.

Q 20—*What is a column pipe?*

A—This column suspends a wet-pit pump from its supporting base. • With propeller and deepwell turbine pumps, the column pipe acts as the discharge pipe and is also called the discharge column. The column pipe may also be called a drop pipe.

Q 21—*What is a pump head?*

A—On deepwell turbine pumps a pump head is the entire driving element and the part mounted on the supporting floor to which the suspended parts are attached. It includes the discharge elbow in case of above-ground discharge, the stuffing box, oiling devices, couplings if used, in fact all parts of the unit above the supporting floor, Fig. 8.

Q 22—*What is meant by inclosed shafting or inclosed line shaft?*

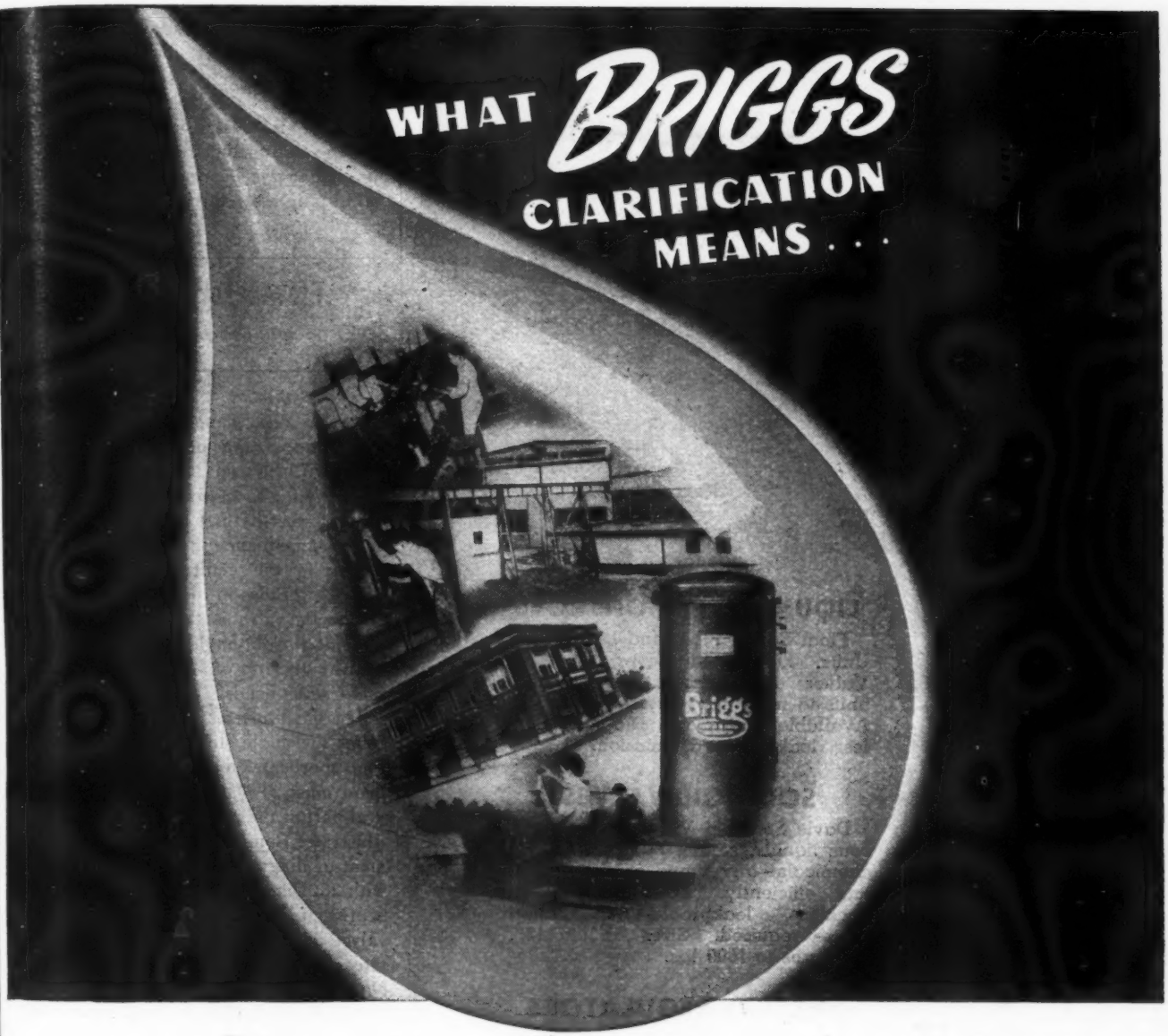
A—In vertical wet-pit deepwell turbine pumps, the shaft is partially below water level. One construction incloses the shaft in a pipe of slightly larger inside diameter so oil can be fed to the various bearings. This cover pipe is generally made in sections with the bearing bushings acting as pipe couplings, Fig. 8. Pumps, so built, are said to have inclosed shafting or inclosed line shaft.

Q 23—*What is meant by above-ground discharge and below-ground discharge?*

A—These terms come from deepwell-pump practice and apply to deepwell turbine pumps and to various wet-pit centrifugal pumps. "Above-ground discharge" now means that the pump is arranged so that it discharges at a point above its supporting floor, Fig. 8, while "below-ground discharge," means that the pump discharges below the floor from which it is hung.

Q 24—*How are the bearings of a deepwell turbine-pump lubricated?*

A—Either water or oil lubrication is used for the pump bearings. If water lubricated, the water pumped acts as the lubricant, the shaft being open to the water. When oil lubricated, the shaft



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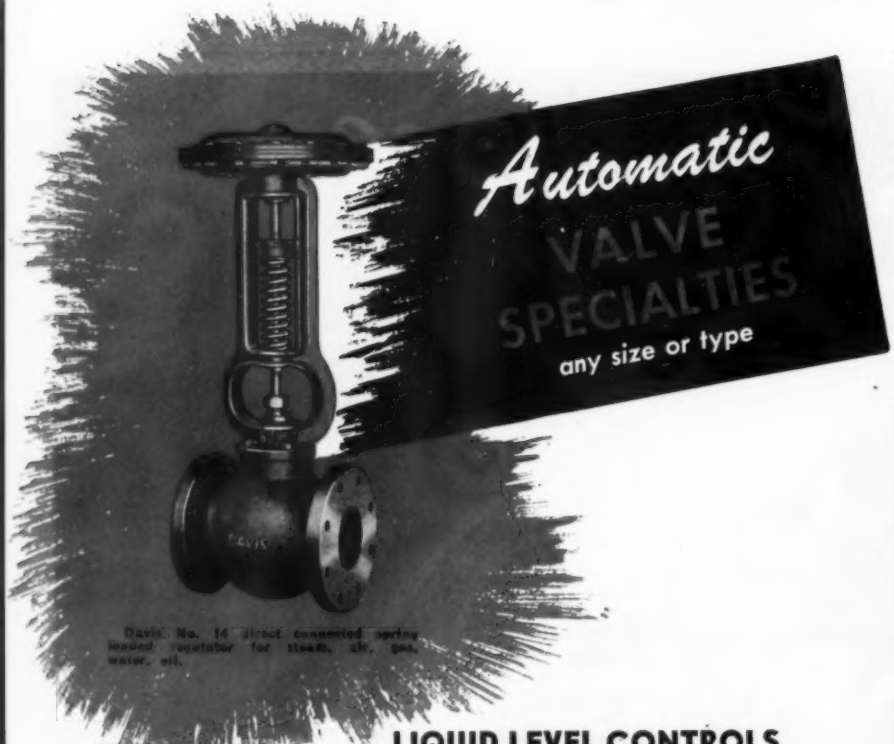

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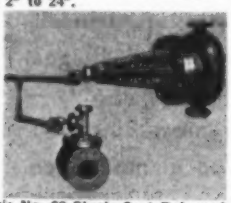
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must be inclosed by a pipe, as in Fig. 8, so that oil can be fed successively to the different bearings. Most deepwell turbine pumps have a bearing below the impeller. This bearing in some designs is water lubricated and in others is grease lubricated, the grease being packed in the bearing when the pump is initially assembled.

Flowmeter Accuracy

(*Continued from page 76*)

the valve outlet flange and consider only the piping arrangement beyond. This is clearly illustrated in diagrams 28, 29 and 30, Fig. 4. In diagram 28, the angle valve forms the first bend of a 2-bends-in-the-same-plane combination, thus calling for the requirements of schedule 1 or 2, whereas in diagrams 29 and 30, the angle valve is the first bend in a 2-bends-at-right-angles combination, requiring the use of schedule 3 or 4 for long-radius bends.

If a bend instead of straight pipe precedes the angle stop-check valve, as at the superheater outlet, diagram 34, this bend must also be considered an integral part of the piping arrangement. To illustrate: Compare the piping arrangement of diagram 34 with 27, and of 33 with 28. Diagram 34 is similar to 27 except that a bend precedes the angle valve, at right angles to it. This dictates that schedule 4 requirements for elbows be followed instead of schedule 7. Similarly, the bend preceding the angle valve, diagram 33, is at right angles to the bend following the valve, thus requiring schedule 4 for long-radius bends, whereas diagram 28, with the same piping arrangement following the angle valve itself, requires but schedule 2.

Diagram 27 illustrates an important point in schedule 7, namely, when two valves are close to each other in series, the one having the stricter requirements governs, regardless of its position in the assembly. In other words, you cannot take the requirements of an open gate valve alone, as in diagram 27, just because the gate valve is closest to the orifice or nozzle unless the distance between the two valves is equal to, or greater than, the difference in the requirements of these two valves, as given in schedule 7.

For example, assume a 75% diameter-ratio orifice is to be installed in the piping arrangement shown in diagram 27. This orifice would have to be 18 pipe diameters beyond the stop-

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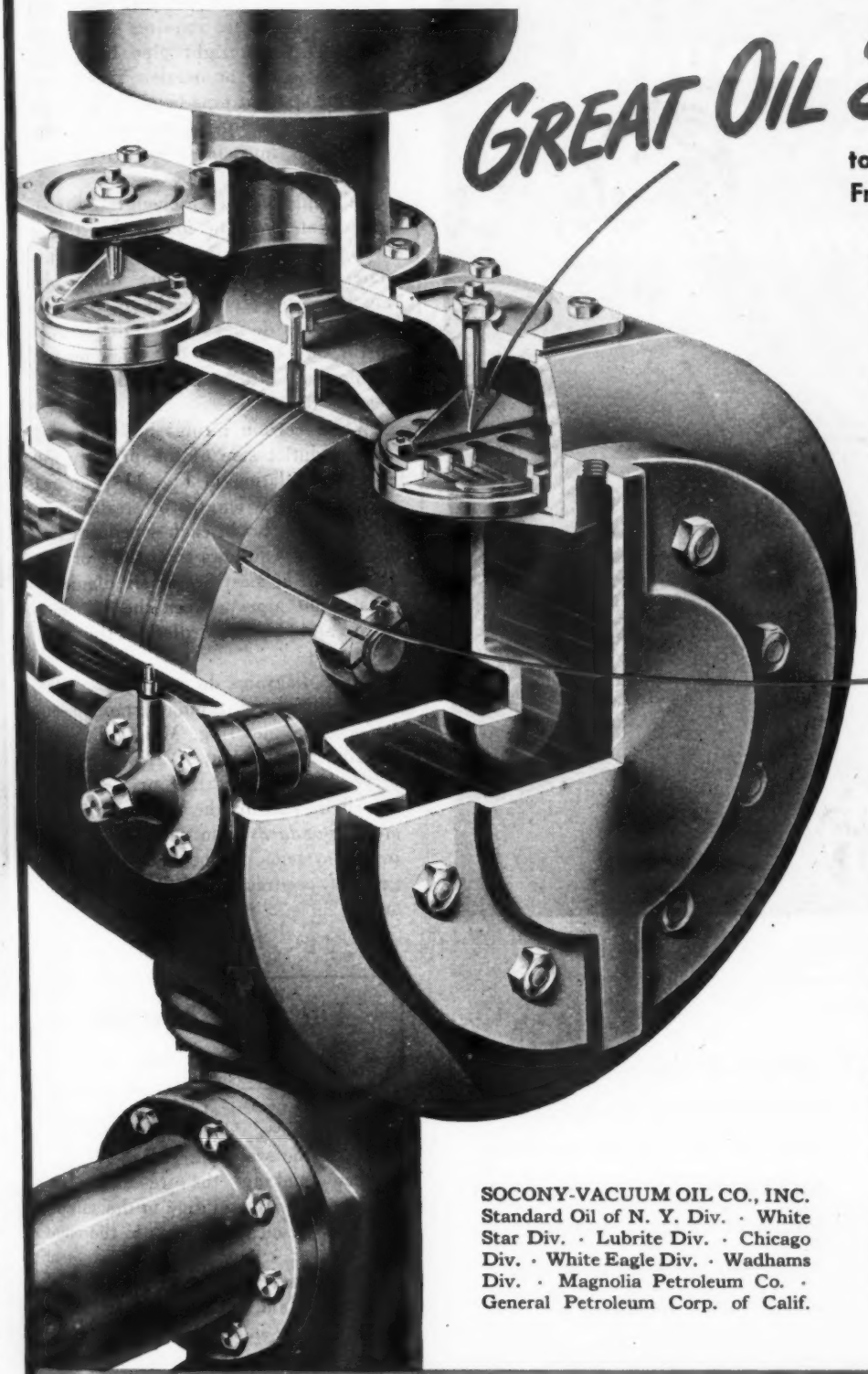

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check valve for satisfactory results despite the fact that the gate valve that follows the angle requires but eleven diameters of straight pipe between it and the orifice or nozzle. This means that the straight pipe between the angle valve and the open gate valve in this installation must be seven diameters in length.

In applying these schedules, Fig. 1, give preference to longer lengths of straight pipe *A* rather than to the alternate use of straightening vanes with much shorter pipe lengths, *C*. Straightening vanes do not correct all forms of disturbances and, in fact, may tend to perpetrate rather than eliminate irregular flows.

While certain fittings are permitted on the outlet side of the primary element (tabulation in Fig. 1) preferred arrangement is lengths of straight piping *B* called for in each schedule. If a control valve follows the orifice or nozzle, install at least five or six diameters of straight pipe between the orifice or nozzle and valve regardless of the diameter ratio.

These diagrams do not represent the only satisfactory piping arrangements for accurate metering. Many others are equally good or better. However, they serve to illustrate the principles involved in putting the *Piping Requirement Standards* into practice so that piping systems can be laid out to give greatest accuracy to the metering element.

Bite Out of Ammonia

(*Continued from page* 94)

process assures delivering the desired dosage to the system.

When making the residual test, quickly add ortho-tolidine to the sample while paying close attention to the color development. Slow color development indicates that treatment is short of break point, and more chlorine must be added. Dosage should be increased until there is no doubt regarding the rate of ortho-tolidine color development. Take readings instantly after adding ortho-tolidine and again at the end of five minutes. Table II indicates typical test results ahead of, at, and beyond the flash point when the desired control is 1.0 ppm. Figures in *A* and *B* indicate chlorination short of the control flash point; in *C*, chlorination at the control flash point; in *D*, chlorination beyond the control flash point.

This method eliminates a large pro-

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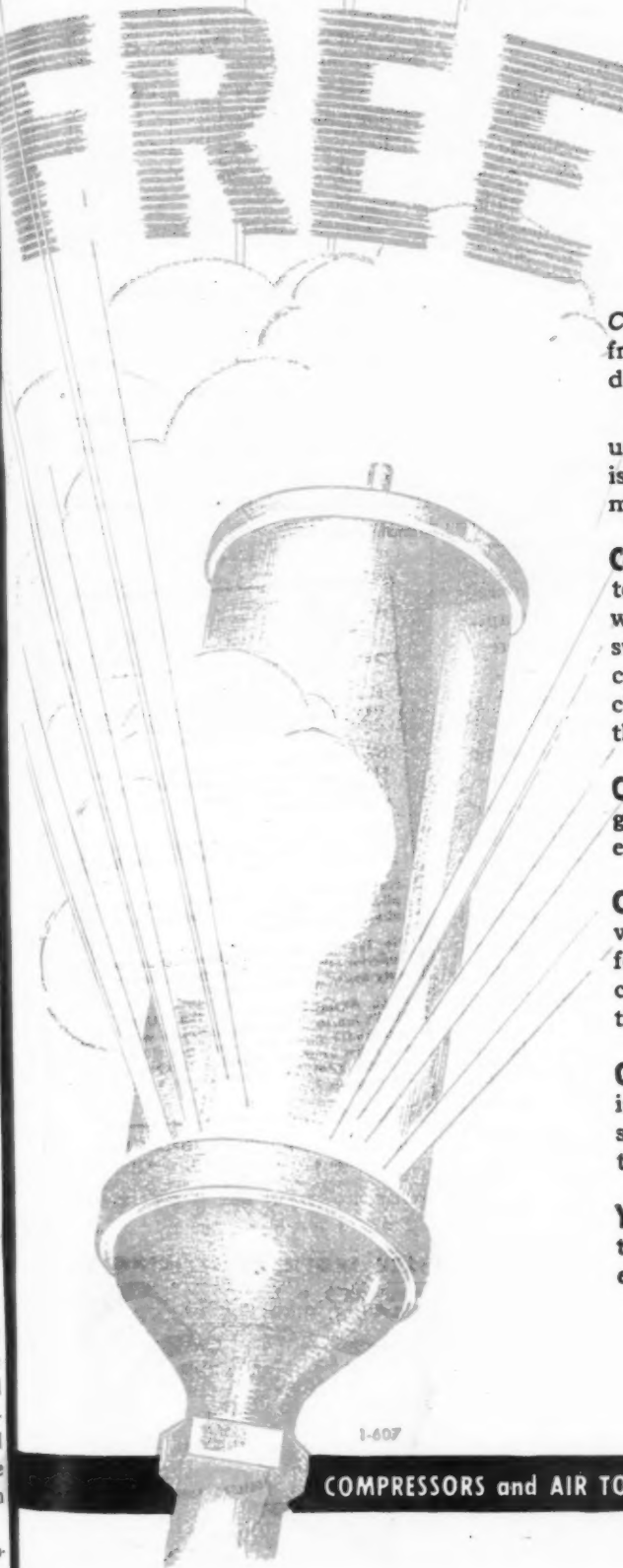

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Compressed Air supplies oxygen for combustion in oil, gas, and coal furnaces and boilers on land and sea. It is essential in blast furnaces and foundry cupolas.

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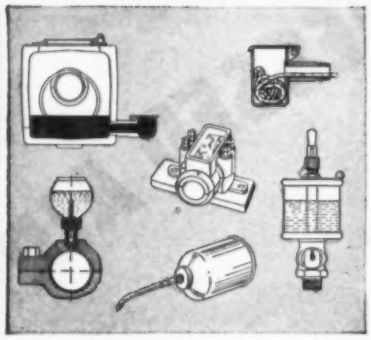

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portion of the time-consuming jar tests. However, sufficient time must be allowed for chlorine and water contact before applying the test, for almost all water *flashes* (instant color appearance) within the first few minutes after adding chlorine assuming, of course, that any residual is present. The test is most sensitive at the lower temperatures and readily discernible at 70 or 80 F. At 100 F., however, difference in speed of color formation is barely discernible.

The previously outlined experiments show that (1) free ammonia can be removed from water by chlorination (2) ratio of chlorine to ammonia should be 10:1 or more (3) speed of reaction between chlorine and ammonia is influenced by water pH and temperature and (4) completion of the reaction is a function of contact time, and can be determined by the Laux Flash Test using ortho-tolidine.

Air and Condensate

(*Continued from page* 73)

(6) Good engineering practice requires strainers ahead of all traps. This is particularly true of high-pressure units, Fig. 3B.

(7) It is good practice to install a dirt leg below the trap, Fig. 3B.

(8) Blow out the line before hooking up a trap.

(9) Bucket traps must have water in the body at all times and should be primed when installed as there may not be enough accumulated condensate in the system to float the bucket (catch the prime). If insufficient water reaches the trap to prime it, the bucket does not become buoyant and the trap blows steam.

(10) A trap operates when placed above the system being drained provided it has sufficient capacity at the differential pressure available and there is enough pressure to lift the condensate to the trap. When locating a bottom inlet or inverted bucket trap above the unit being drained, install a check valve on the inlet line (close to the trap) to prevent back flow and loss of water seal, Fig. 3C. A small pipe length screwed into the body of a bottom-inlet trap (about 2 in.) provides an effective seal, Fig. 1D.

The commoner trap troubles are:

(1) If it takes too long to bring steam-heated equipment to desired temperature, the trap may be too small or have insufficient air-handling capacity.

(*Continued on page* 148)

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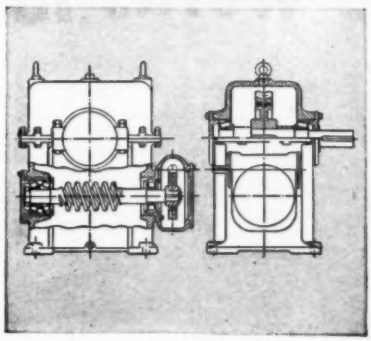

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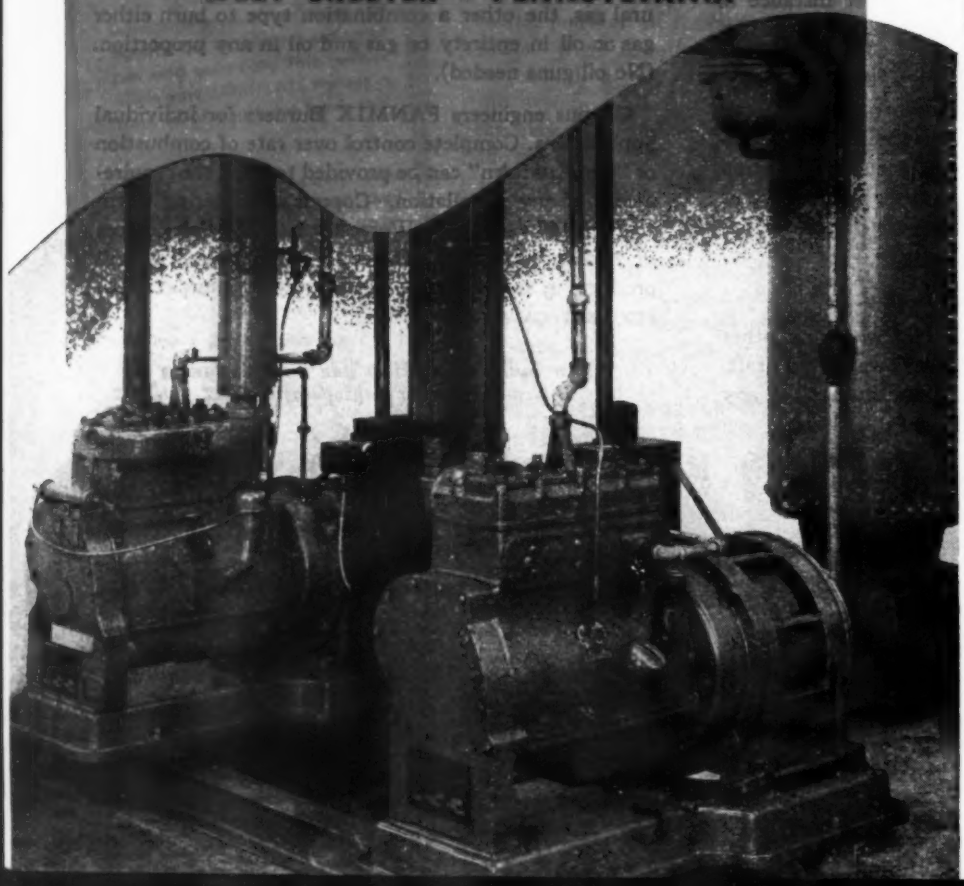

Check this by opening the bypass or blowoff to see whether condensate has backed up in the machine.

(2) Check the pressure on heating and process units at regular intervals. Too high pressures may damage thermostatic traps. Mechanical ones may not be able to open against higher differential pressure. If steam pressure is too low, the unit does not get enough steam and trap capacity may be inadequate at the new differential pressure.

(3) On a manually controlled drain valve, or traps with manually adjusted orifices, make frequent checks to determine whether the setting is such that no steam escapes but all condensate is removed. The latter usually carry a gage glass or indicator to show condensate level.

(4) When discharging to a vacuum system see that all parts of thermostatic or bucket traps, including union and cover, are tight against air leakage.

(5) If a bucket trap fails to discharge, be certain that condensate actually reaches it. Trap may be clogged with dirt. Be sure the differential pressure (inlet minus outlet) is the same or less than the valve-and-seat rating stamped on the body.

Check Backpressure

(6) When a bucket trap discharges continuously it may be too small or clogged with dirt. Or perhaps backpressure on the outlet reduces the differential pressure to a point where trap capacity is inadequate. For example: Trap orifice may be rated at 50 psi for use on 50-psi inlet pressure with discharge to atmosphere. Should backpressure build up to 20 or 30 psi, differential pressure is so reduced that trap capacity is negligible. Therefore it would naturally discharge continuously.

(7) Frequent trouble occurs when traps are purchased for certain operating pressures and later installed on higher-pressure systems. Or sometimes the system pressure may be raised. Nearly all buoyancy traps have valves and seats that can be removed and replaced with ones of correct area for the new pressure.

(8) Steam lines frequently contain dirt, scale, packing or gasket material that finds its way to the trap and lodges between the valve and seat. Use a strainer to prevent this.

(9) When traps drain units of different pressures and discharge into a common return line, the common backpressure may be considerably higher than the inlet pressure on a trap of low inlet pressure. Of course, steam and condensate back up through this low

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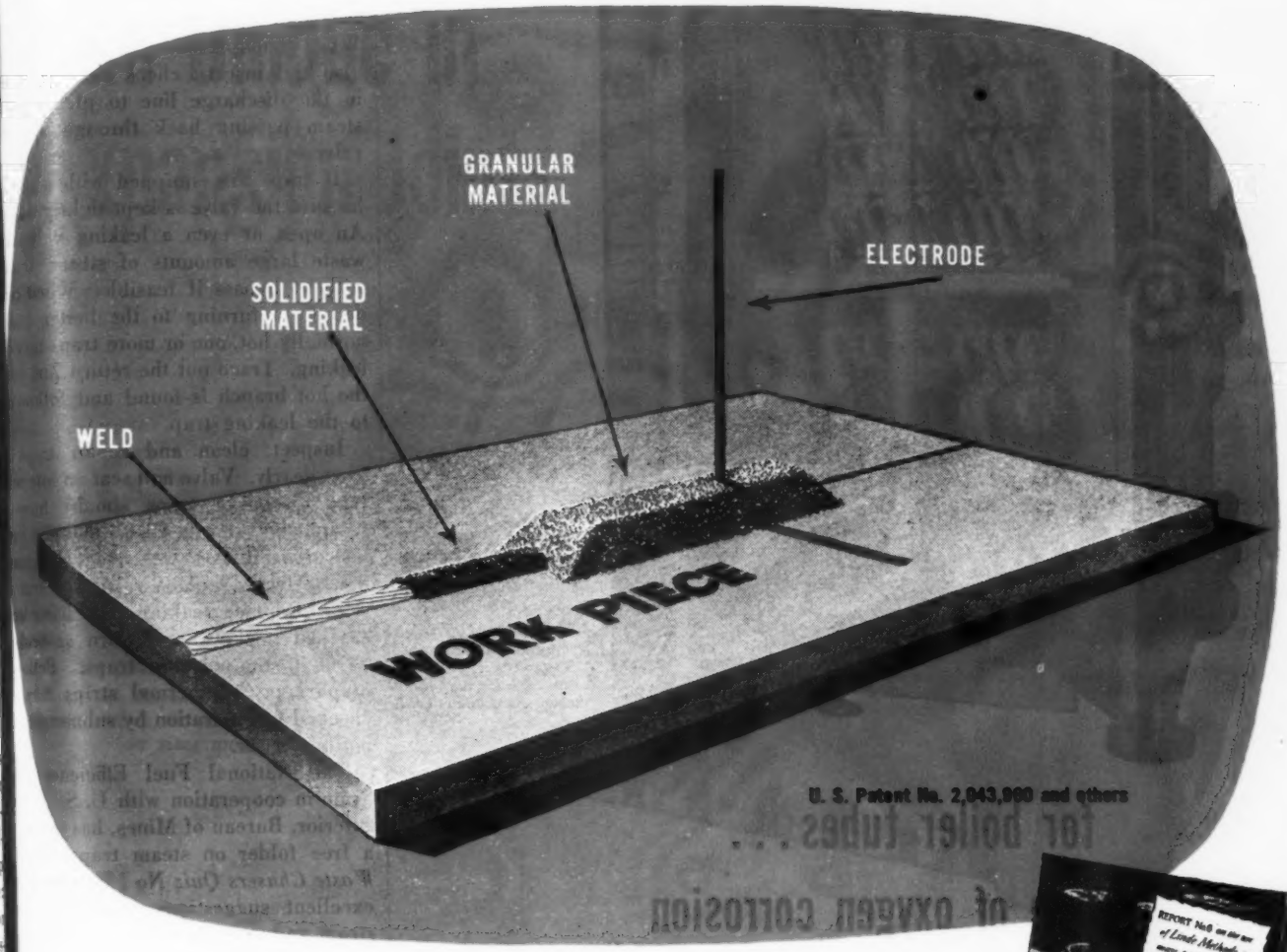

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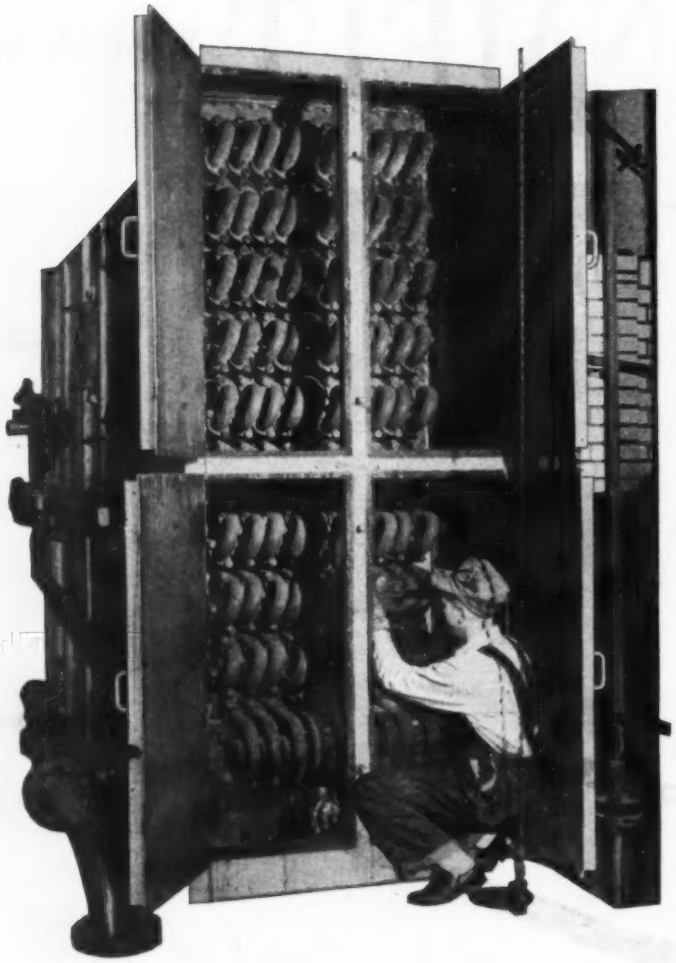

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For samples and complete information on using Santosite in your boiler feed water, address: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

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pressure trap and flood the heating unit.

Equip all traps except small radiator ones with valves on the discharge side for periodic testing for leaks. If there is no test outlet on the trap, insert a tee and plug in the discharge line. When backpressure in the return is also high insert a check or shutoff valve in the discharge line to prevent flash steam passing back through the test valve.

If traps are equipped with a bypass be sure the valve is kept tightly closed. An open or even a leaking valve can waste large amounts of steam. Install without bypass if feasible. When condensate returning to the boiler is abnormally hot, one or more traps may be leaking. Trace out the return line until the hot branch is found and follow up to the leaking trap.

Inspect, clean and repair traps at least yearly. Valve and seat on intermittent discharge traps should have a bright shiny mark all around the contact area. Inspect seats for wire drawing. Always replace valve and seat in sets. Replace leaking ball floats and cracked buckets, and worn or broken parts in thermostatic traps. Bellows, diaphragms or thermal strips may be checked for operation by submerging in boiling water.

The National Fuel Efficiency Program in cooperation with U. S. Dept of Interior, Bureau of Mines, has prepared a free folder on steam traps, entitled *Waste Chasers Quiz* No 125, with many excellent suggestions on how to save steam and provide proper maintenance. It may be secured by writing the Bureau of Mines, Washington, D. C.

Reader's Problems

(*Continued from page* 113)

justed that makeup valve opens only after the condensate tank is empty if the feedwater level has not reached normal, thus preventing flooding of the heater. Line A may be used only in emergency should the pump or motor be under repair.

Kearny, N. J. GEORGE MCNALLY

Traps May Be Airbound

THE MACHINES may get cold because (1) condensate return line may be too small, or condensate flow too heavy (2) steam traps may need cleaning or repairing (3) bypass on one or more traps may be open, thus creating a backpressure in the return line. (4

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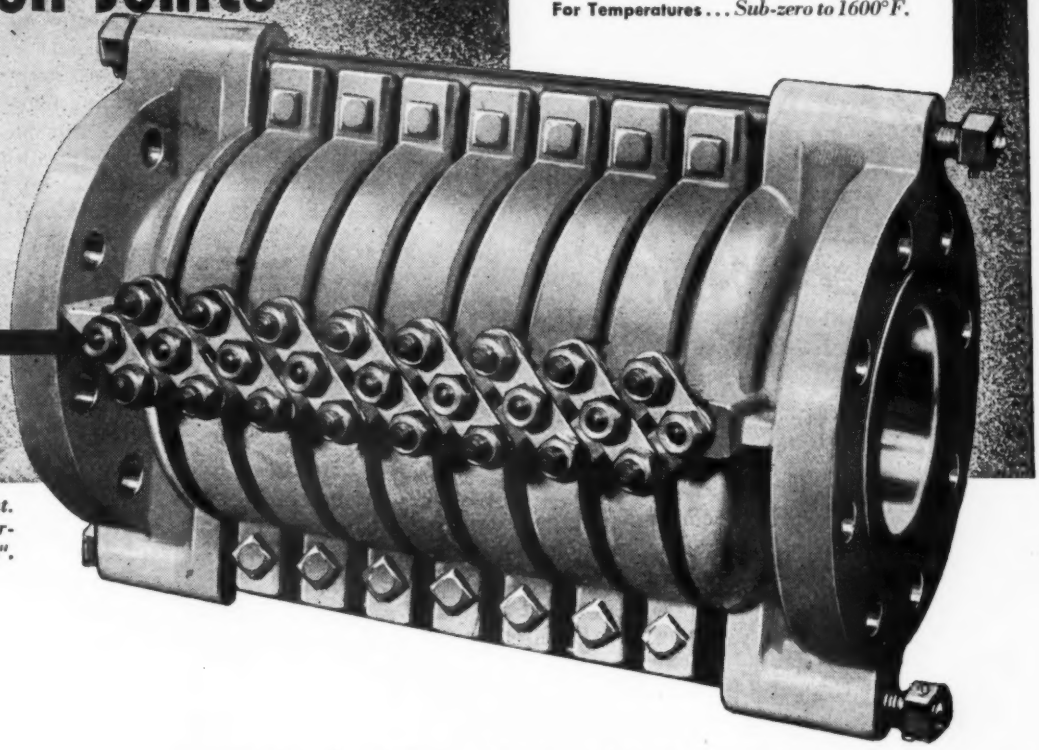

4" Diameter Expansion Joint. Alignment rods shown are furnished only on sizes under 6".

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traps may be airbound and need venting (5) feedwater heater may be too small to handle the condensate returns when starting the machines (6) return line may be too long, thus creating a high backpressure at the end of the line and at the bottom of the riser to feedwater heater.

I suggest that all traps be cleaned and repaired. If this does not correct the trouble, install two condensate return lines. One will serve the 100-psi steam main and the steam generator traps, the other serving only the traps connected to the various machines. To assure good operation, install a collecting tank, and empty the condensate returns into it. A small centrifugal pump controlled by a float switch can empty the tank into the feedwater heater.

Newark, N. J. R C Conk

Install a Hotwell

The air that emerges when CHH opens the bleeder valve is doubtless that entrained in feedwater makeup. This is discharged through bucket traps and stratifies in anticlines of the condensate line when flow ceases. In spite of the statement that the traps connect into the 100-psi steam main, it is not clear that this is so. With buckets and ball floats submerged when the system is waterbound, a pressure of 100-psi operating through 21 trap orifices should blow everything in the condensate line into the heater unless that vessel is closed and under high pressure.

An intentional or accidental change of the setting of a pressure-reducing valve in the steam main could easily produce the trouble. Also, if there is no separate pressure gage on the steam line to the laundry, an incompletely opened non-return valve on the boiler might be the cause. Too high pressure in a closed heater, or a closed butterfly valve in the vent line of an open heater, might hinder normal condensate entrance.

Since CHH does not mention condensate pumps, only two forces act to return the condensate—gravity and steam pressure. Assuming a 1% slope in the return line (0.01x2000 ft equals 20 ft) a 20-ft head of condensate could possibly accumulate in it. Since this is 5 ft less than the 25-ft lift into the heater, an absolute minimum of 2.2 psi at the laundry traps is necessary to get the condensate up to the heater level.

This disregards resistance to flow in the return line, pressure in the heater, obstructions, and a slope of less than 1%. When all possible factors are considered, a minimum steam pressure

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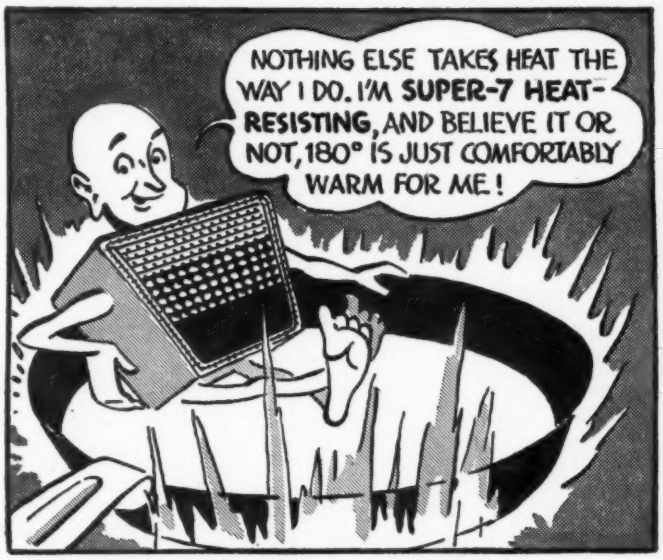

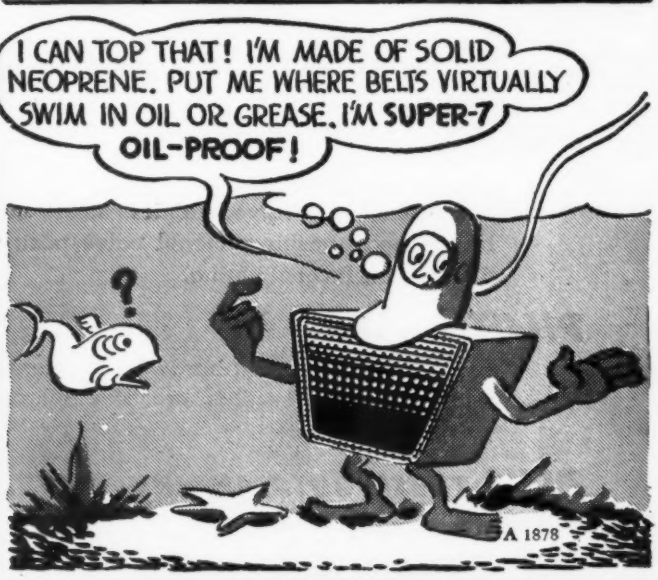

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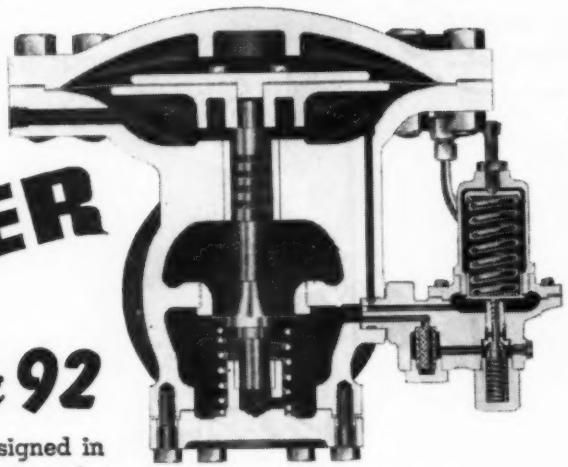

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of 5 to 10 psi at the traps is needed.

Since the return line will work if the bleeder is open, best solution is to install a hotwell at the power plant into which the condensate could spill. A small float-controlled centrifugal pump could then lift it into the heater even against pressure.

Marissa, Ill. GEORGE HOLMAN

Does High Lift Cause the Trouble?

IT IS QUITE EVIDENT that the 25-ft rise (together with the possibility of air leaks) is to blame for the poor operation.

I suggest that the condensate return line empty into a tank (or concrete pit) located below the return-line level. Check the return line to see that it has no high points that form air pockets but has free discharge into the return tank. A small centrifugal pump controlled by a float switch will lift the condensate into the heater. Protect pump suction opening with a screen and put a check valve in the discharge line.

Brooklyn, N. Y. A J WENIG

Return Pipe May Be Too Small

IF CHH USES an open heater he should check the following:

(1) Heater vent should be large enough to prevent building up pressure inside.

(2) Heater should be high enough to insure pressure on suction side of boiler feed pump.

(3) Return pipe should be of ample size to carry returns from all machines allowing for friction, which is considerable in 2000 ft of pipe.

(4) Check all traps for leaks because this could cause part of the trouble.

Winona, Minn. T A MUELLERLEILE

What Becomes of Low-Pressure Returns?

THE 2000-FT RETURN LINE plus a 25-ft rise to the feedwater heater causes the traps to work against considerable head. Therefore, they are always loaded on the condensate side. How about the low-pressure steam generator? If low-pressure traps dump into the same return line with the 100-psi traps, the constant head on the return may feed back into the 1-p line if the return head is higher than the 1-p steam pressure. A check valve would prevent this back surge, but the 1-p

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trap would not work at all because of the higher head on the return.

Condensate flow from a laundry is considerable and warrants an automatic return pump with attached float-reservoir tank. Set the return pump either at the foot of the riser or near it. For gravity flow to a pump near the 25-ft riser, return line should be not less than 2 in. If the pump is near the laundry, return line could be smaller. Size of return, whether straight or with many or few turns, and accuracy of grading must be taken into account.

CHH might try connecting a domestic-hot-water tank above a possible high point in the return line as a reservoir for air liberated from the return water. Bleed this off from a valve in the tank top as often as necessary.

Shiprock, N. M. J F MAHER

Recommends Vacuum Pump

CAPACITY OF the 2000-ft condensate line is inadequate to handle the mixture of air and water against a 25-ft head at the discharge end, but can handle it when the 25-ft head is removed by opening the drain valve. Entrainment of air in the condensate increases its volume and therefore decreases the line's capacity.

Here are several things that will relieve the overload condition:

(1) Reduce air leakage into the return line.

(2) Install air eliminators near the upstream end of the condensate line. This may require combined thermostatic float traps at the runouts of each machine or group of machines as well as air vents on the return main. Air vents on the main should be installed on top of ample-sized air chambers so the entrained air will not be carried past the vent.

Install a vented receiver and condensate pump at the foot of the line and pump the condensate into the feedwater heater.

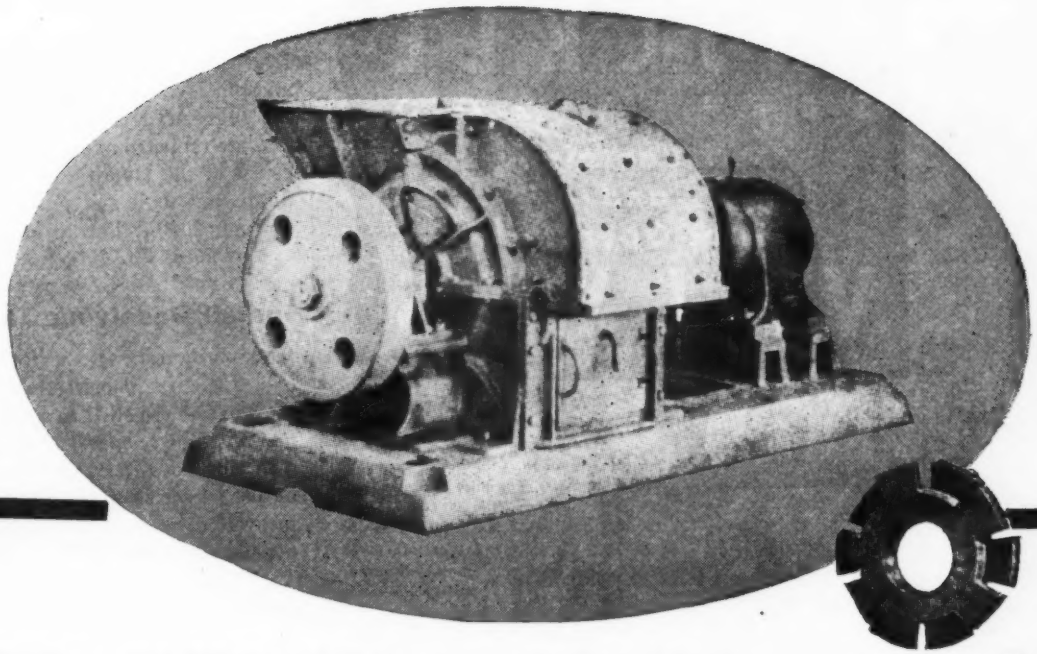
(4) A tilting trap may be used in place of the condensate pump with better economy.

(5) Installing a vacuum pump instead of a condensate pump at the riser or placing the condensate pump near the last inlet to the line would increase the line capacity.

Oak Ridge, Tenn. I A BUTCHER

Trap Strainers May Be Dirty

IT IS OBVIOUS that the traps are not getting rid of the condensate. This may be caused by one or all of the following:



EVERY PLANT HAS A DIFFERENT PROBLEM IN COAL PREPARATION

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Your requirements in coal preparation are probably as different from those of the plants shown here as each of these plants is from the other. Yet there is an "American" satisfactorily serving the needs of preparing coal for combustion in every one of these installations.

The obvious reason for the wide use of American Rolling Ring Crushers is their wide field of utility . . their versatility in handling all grades of coals and in preparing them to the proper degree of fineness, *at low cost*, for the specific requirements called for by operating conditions.

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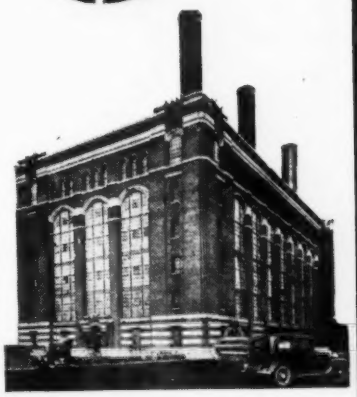

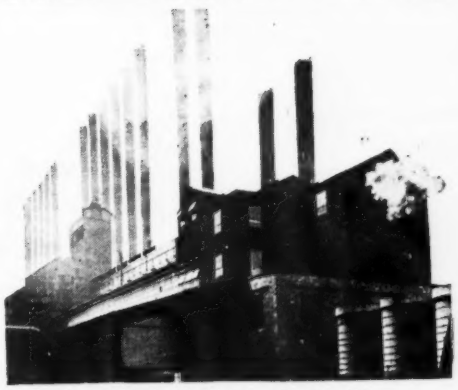

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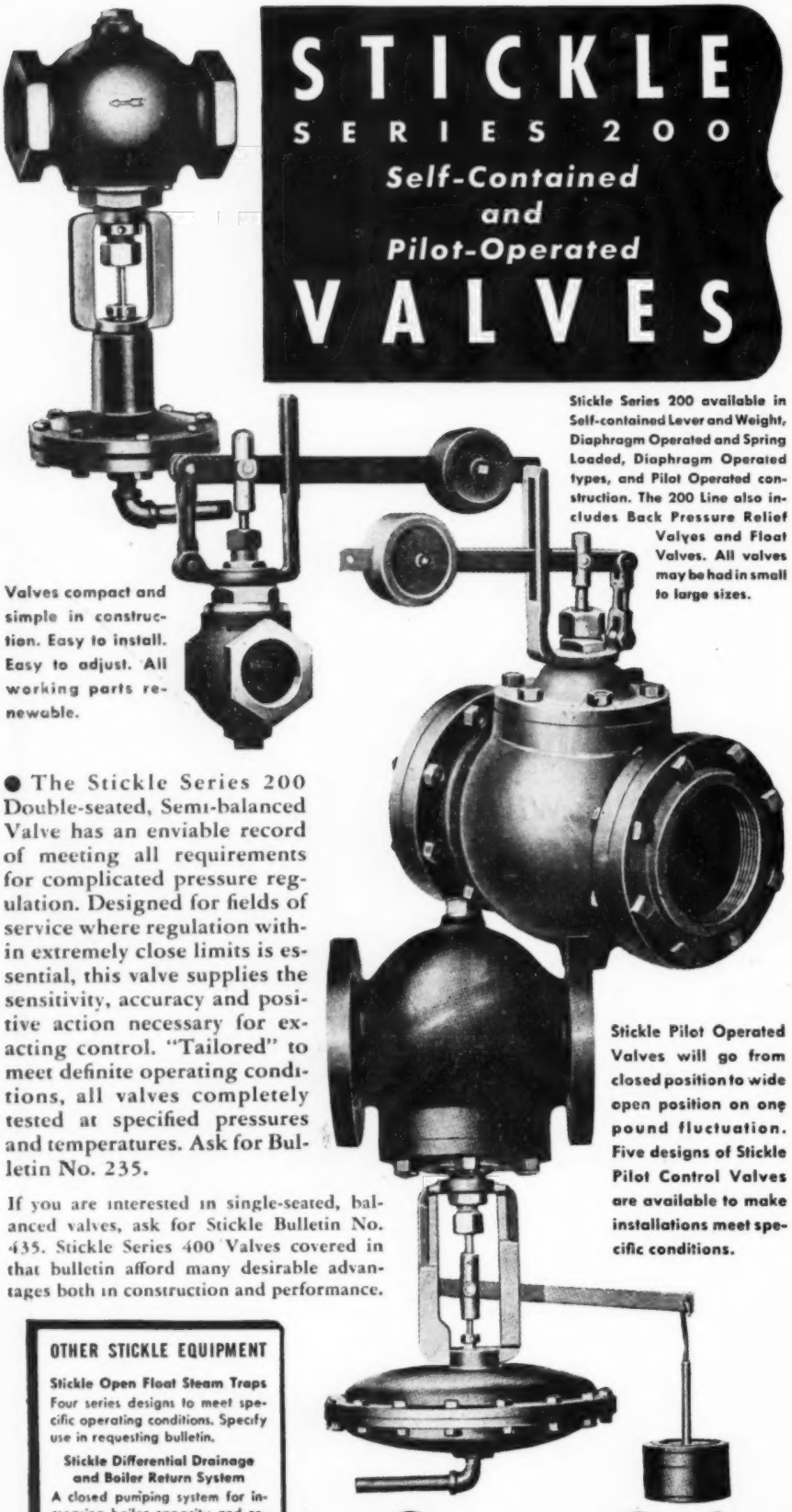

Stickle Series 200 available in Self-contained Lever and Weight, Diaphragm Operated and Spring Loaded, Diaphragm Operated types, and Pilot Operated construction. The 200 Line also includes Back Pressure Relief Valves and Float Valves. All valves may be had in small to large sizes.

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(1) faulty traps (2) dirty strainers (3) too much backpressure on traps (This is caused by friction in the 2000-ft line and the 25-ft riser.)

I suggest CHH install a duplex condensate-return pump with a vented receiver at the laundry, connect the trap discharges to it and pump the returns through 2000-ft line to boilerhouse.

Yorktown, Va. I R BERKNESS

Install Receiving Tank

WHEN TURNING STEAM into cold machines such as mangles and dryers, all air must be expelled to bring machines up to proper operating temperature. The fact that the return condensate has to be lifted 25 ft in order to reach feedwater heater introduces about 10 psi back pressure on main return line. This keeps the line sealed instead of vented. One way to eliminate the trouble is to install a receiving tank at end of return line ahead of the vertical riser. Receiving tank should be vented. Install a small pump to lift condensate from receiving tank to feedwater heater.

Key West, Fla. L H ESCHEN

Check Trap Installation

IT APPEARS that CHH does not have his traps installed properly, or the heater vent is closed. A good blast trap on the vertical line to heater would eliminate the trouble because it is designed to bypass the air automatically. They are desirable where large amounts of air are present. Also try changing the traps and use U-bends that drain the lower coils. Install check valves to prevent back flow and loss of prime.

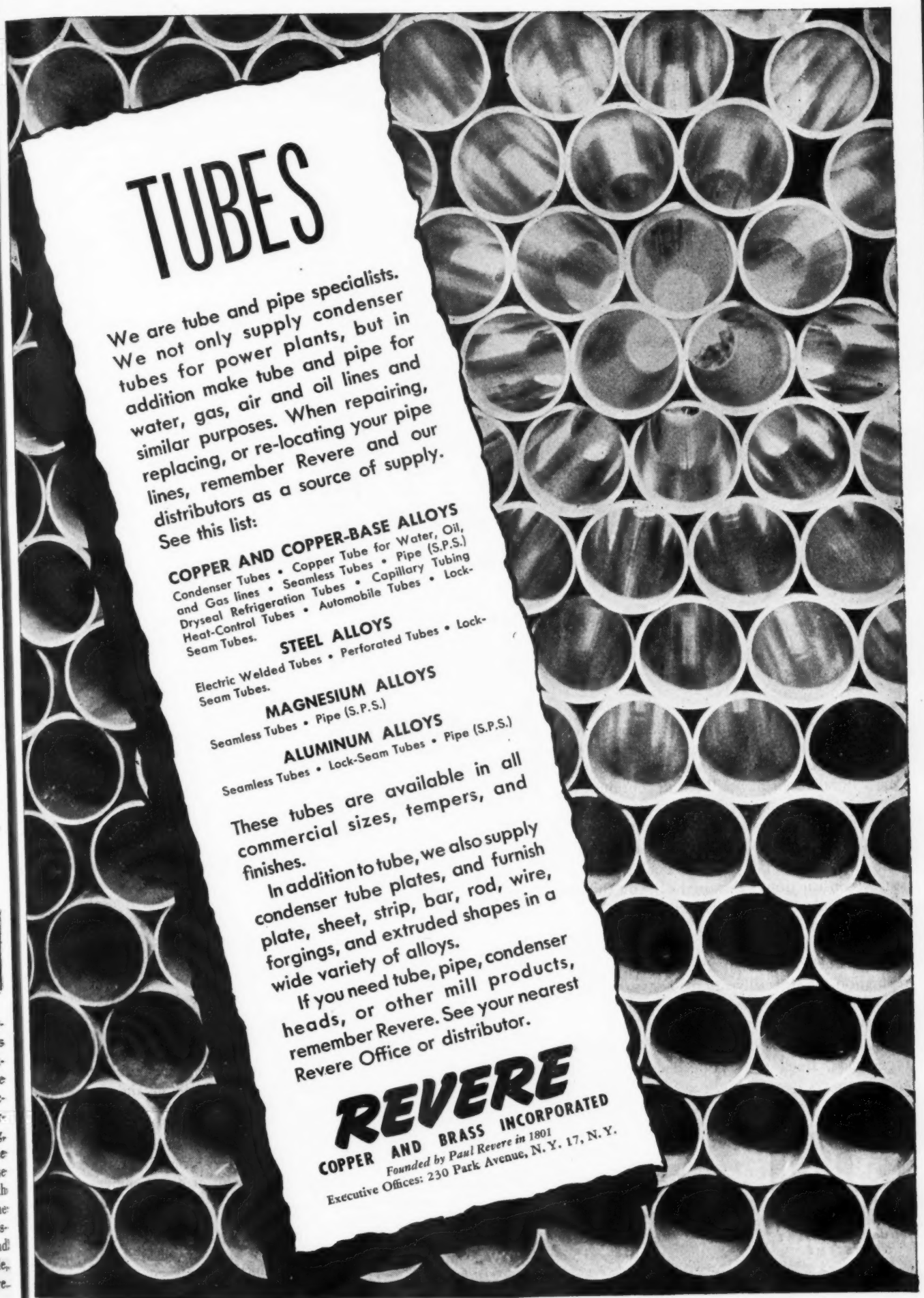
Oaklyn, N. J. C A WILKES

Diesel Operation

(*Continued from page* 85)

of failed bearings, should be as thorough as possible to facilitate analysis of the cause and to make recommendations which will decrease or eliminate future failures. Such inspection records should include sketches of the bearing showing location of lost lining, cracks, pits, corrosion and other surface irregularities and discontinuities. These sketches should be supplemented with data on engine characteristics, engine operating hours, bearing characteristics and location, bearing hours, and type, grade and analysis, if possible, of lubricating oil at time of failure.

(*Continued on page* 162)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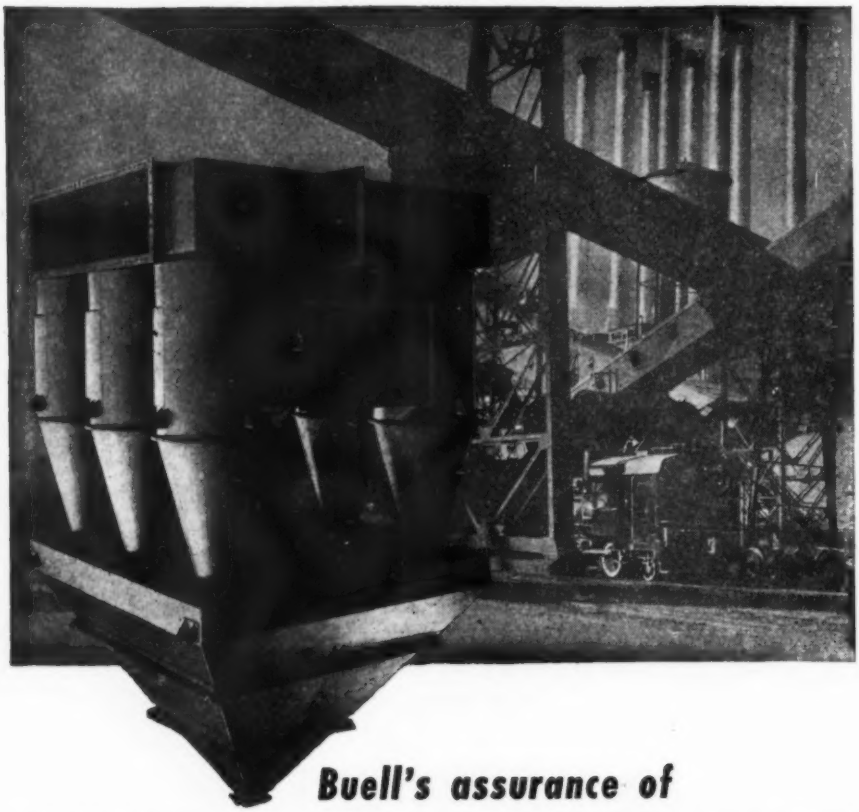

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Manufacture of small crankshafts permits a high degree of accuracy, with uniformity of diameter, small tolerances and high surface finish. Bearings for such small journals are interchangeable and do not require hand fitting. Of necessity, large crankshafts involve somewhat greater tolerances and less smooth journal surfaces. Bearings for large journals thus often require hand fitting by experienced personnel. With bearings properly fitted, desired clearances maintained and engine parts in alignment, good maintenance requires use of approved lubricating oils kept in proper condition. Adequate oil cooling diminishes possibility of rapid oil oxidation. It is recommended that oil be analyzed at appropriate intervals depending on service conditions, to check for dilution and oxidation. Sump-oil samples, drawn from the lowest point, should be inspected for metal particles and the sump-oil filter screen should be checked. Cleanliness in handling bearings during inspection and assembly is vitally important to good operation.

Other Papers Presented

At another session of the same meeting, Troels Warming, mechanical engineer, Nordberg Mfg Co, presented a paper "Polar Diagram for Tuning Exhaust Systems." It has long been known that under certain conditions, proper "tuning" of the exhaust system improves diesel-engine performance, but determination of natural frequency of such a system has involved tedious and complex computations. By use of the method and polar diagram developed by Mr Warming, the natural frequency of even a branched system may be determined rapidly and without higher mathematics. A number of typical examples are worked out in the paper.

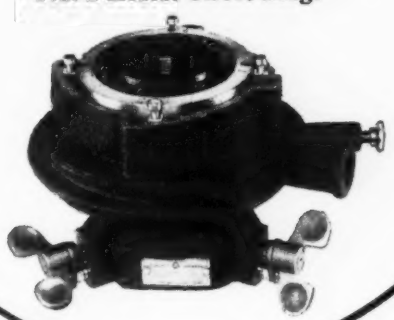
In the concluding paper of the program, O A Uyehara, P S Myers, K M Watson and L A Wilson, of the University of Wisconsin, described the theory, development and calibration of an electro-optical pyrometer capable of determining instantaneous true temperatures of luminous flames and the auxiliary apparatus to obtain simultaneous values of pressure, temperature and crank position in an internal-combustion engine. This instrumentation permits much-needed research in the combustion behavior of diesel engines.

Office of War Utilities approves installation of a 45,000-kw steam turbine generator at South Meadow plant of Hartford Electric Light Co, Conn. Unit will go on the line early in 1946.

For the big job in *New Building*

When you unfold the blueprints for new homes... new commercial buildings... new plants and reconversion... start the job *right* with TOLEDO Pipe Tools! These are the tools for best work by green hands or experienced mechanics—unbeatable for accurate, reliable, easy-threading operation for nearly half a century.

Toledo Engineering Leadership designed this ahead-of-the-times tool... the Toledo SIMPACT Threader! Entirely self-contained, adjustable for 1″ to 2″ pipe. Sizes changed instantly with one set high speed steel dies. Accurate, dependable. Specify TOLEDO for better pipe tools and better building! The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Bldg.



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LIP PACKINGS
Leakproof, "Automatic"

GOODALL "Long-Life" Lip Packings are as completely "automatic" as possible, with pressures developed in the mechanical unit directly governing the sealing action of the rings. Being sensitive to pressure changes, they do not require gland pressure. If properly installed, subsequent adjustment to compensate for pressure changes should not be necessary. Channels formed between rings serve as reservoirs for lubrication.

"Long-Life" Packings are furnished in ring form only, solid or split, in all rod and stuffing box sizes. Each set consists of one bottom adapter ring and a sufficient number of pressure rings to provide the required depth.

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STYLE PH-141. Duck and Rubber. For hot or cold water, low pressure steam, ammonia, cold oil; hydraulic equipment, such as presses, triplex pumps, airplane struts, shock absorbers, etc.

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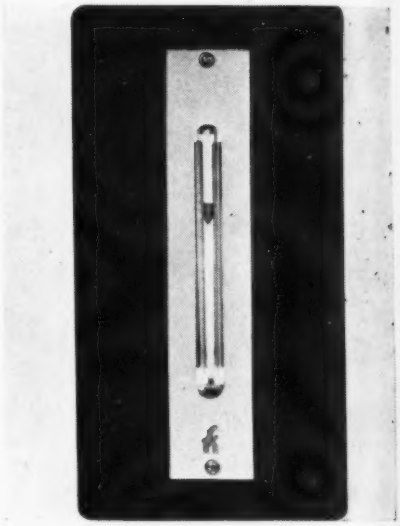
Established 1870

New Equipment

(*Continued from page* 126)

handles and a 15-ft supply cord with plug are also included. One of the indicating voltmeters measures voltages up to half of maximum rating and the other up to full test voltage. These sets are in rectangular steel cases mounted on 3-wheel trucks and grounded through the third conductor in supply lead. When sets are not in use, three leads are coiled and hung on hooks attached to rear panel of case. *General Electric Co, Schenectady 5, N. Y.*



Flow Indicator

DESIGNED FOR PANEL centralization of instruments that indicate pressure, flow, temperature, etc, new panel-mounted *Rotameter* offers several advantages. Although the instrument itself is basically the S-K Universal *Rotameter*, the panel-mount has a frosted glass window with a central clear-glass aperture and is installed flush in the panelboard, with *Rotameter* supported directly behind. Provision is made for adequate back lighting and ready maintenance accessibility. *Schutte & Koerting Co, 12th and Thompson St, Philadelphia 22, Pa.*

Alloy-Steel Vise

QUICKSET ALLOY-STEEL VISE, 3 in., is manually operated but eliminates running in or out the screw to close or open the vise. This speed vise can be set and closed quickly by simply pushing on body of free jaw, which slides in swiftly on ratchet screw and two precision guide rods and tightens with a turn of the handle. Vise has a trigger release pawl with $\frac{3}{4}$ in. of thread, which holds hardened screw under spring tension. Vise opens instantly to full 3 in. by pressure of thumb or finger on trigger release after tension has been eased by single turn of handle. *Quikcet* vise is then ready, without further adjustment, for closing on any other work.

Vise is spatterproofed for welding, with

How Allis-Chalmers Engineering Discovers New Ways to Build Better Motors for You.

WANTED: D-C Motors to Dive for Navy!

BUILD SUBMERSIBLE MOTORS to run 25 feet under water — and build 'em to run that way 90 days at a stretch! That's the tough assignment Navy engineers turned over to Allis-Chalmers.

Those motors had to: 1) withstand sea pressure; 2) stay waterproof; 3) be light in weight.

No. 1 problem was . . . *how to build water-tight casings.* A-C engineers experimented, found the solution in fabricated steel.

Quickly, individual casing parts were built. Subsequent hydrostatic tests applied to them showed molecular arrangement and carbon content of steel to be ok. Result —only a heavy weld between fabricated parts was needed to assure water-tightness!

Now the going was easier. For adequate surface seal, field yokes of one-inch rolled steel were used. End housings were reinforced. Exposed adjustments were made leakproof. Then . . . minor changes in insulation, at other points, and the problem was solved.

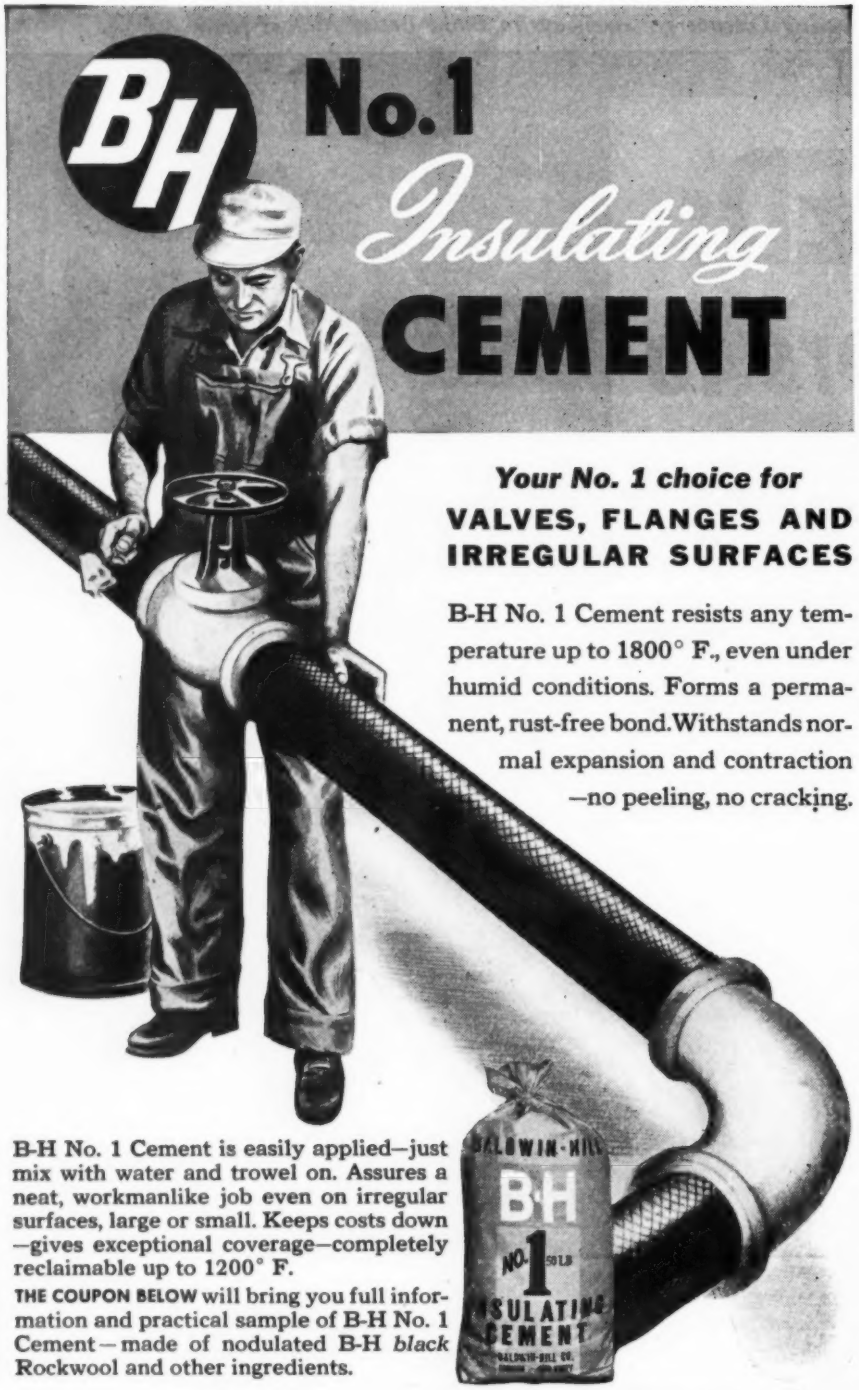
* * *

"What's all this got to do with *my* problems?" you may ask. Just this . . . Everytime A-C tackles the job of building special motors for extra-tough war applications, like this one, it also discovers important new ways to build better *standard* motors for you!

That's why you hear it said so often, *"You can depend on Allis-Chalmers Motors!"* ALLIS-CHALMERS, MILWAUKEE, WIS.

A 1889

You Can Depend on ALLIS-CHALMERS Motors



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VALVES, FLANGES AND IRREGULAR SURFACES

B-H No. 1 Cement resists any temperature up to 1800° F., even under humid conditions. Forms a permanent, rust-free bond. Withstands normal expansion and contraction —no peeling, no cracking.

B-H No. 1 Cement is easily applied—just mix with water and trowel on. Assures a neat, workmanlike job even on irregular surfaces, large or small. Keeps costs down —gives exceptional coverage—completely reclaimable up to 1200° F.

THE COUPON BELOW will bring you full information and practical sample of B-H No. 1 Cement—made of nodulated B-H *black* Rockwool and other ingredients.

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Baldwin-Hill Co., 513 Klagg Ave., Trenton 2, N. J.

Send information on products checked below:

- ☐ Free sample of B-H No. 1 Cement
- ☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)
- ☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.
- ☐ Black Rockwool Blankets (felted between various types of metal fabrics)

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copper plating on all working parts and handles, and rustproofed with gray wrinkle-enamel finish. It is also equipped with polished anvil on top and with bottom screw clamp for quick shifting to any bench or job, as well as with usual slots for bolting to bench in stationary applications. *Grand Specialties Co, 3135 W Grand Ave, Chicago 22, Ill.*

Circuit Tester

MULTIPURPOSE DEVICE TESTS insulation between wires or from wires to ground. It also tests continuity of wires and gives audible positive answers at the point of test. With a special indicator attachment it visually determines polarity. It operates on a hand-cranked generator which develops 500 v dc, regulated to assure a uniform test regardless of cranking speed. Instrument contains no commutators, slip rings, gas tubes, calibrated meters, rheostats or adjustment knobs. *Connecticut Telephone & Electric Div, Great American Industries, Inc, Meriden, Conn.*

Polyphosphate Comparator

TAYLOR COMPARATOR is ideal for polyphosphate analysis. By the Taylor method a complete determination requires only 20 min. After conversion of glassy phosphates to ortho form, two reagents are added separately and blue color formed is compared with the standards. This gives total phosphate content. A determination on the cold sample (no boiling) gives ortho present in sample. The difference is polyphosphate.

Outfit consists of a comparison block con-

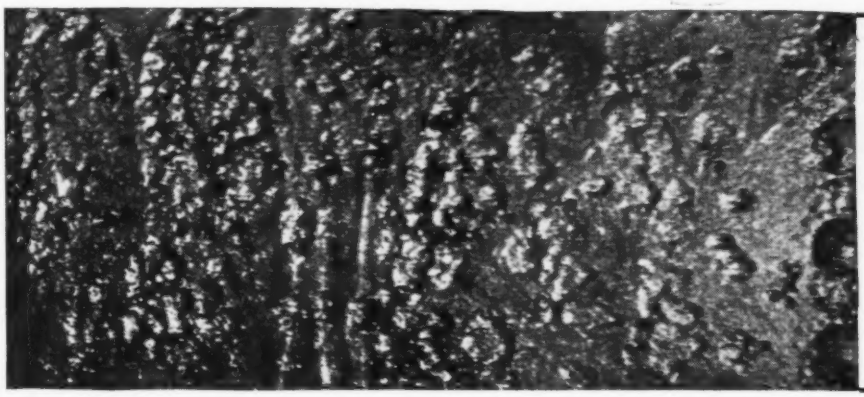
FOR TANK INTERIORS

Corrosion Protection that Has Been Proved at Sea

Here is a corrosion-resistant coating for interiors of all types of cold-water tanks, steel cooling towers and all metal surfaces exposed to water under 125°F.

APEXIOR NUMBER 3 has earned a world-wide reputation in the marine field, having the longest record of success in protecting marine stern plates and condensers against the combination of salt water and electrolytic action.

1,500,000 gallon radial-cone elevated water tank in Texas



This is what happened to a cold-water tank *before* it was APEXIORIZED. But APEXIOR has kept it from getting any worse for nine years. It's an area of a cylindrical open-top steel reserve storage tank, containing potable Boston city water for ice-making. All internal surfaces, some badly corroded, were cleaned and given two coats of APEXIOR NUMBER 3 in 1935. Photograph was made after seven years. No touching up or re-coating has been required since. The coating remains in good condition.

COMPOSITION: APEXIOR NUMBER 3 is a shiny-black paint, a combination of asphalts (100%) dissolved in a suitable solvent. The deposited film when free of solvent is non-toxic and suitable for the coating of tanks to contain potable water.

To prepare for APEXIOR, clean surfaces thoroughly to bare metal — sandblast if possible — then apply two coats of APEXIOR NUMBER 3 by hand brush. An original abrasive blast cleaning (never again necessary) provides a permanent maintenance base upon which APEXIOR protection can be established. APEXIOR is shipped for use as received — no thinner permitted.

Here's economical insurance against rust for any cold-water handling equipment. Get additional details today. Use the coupon below.

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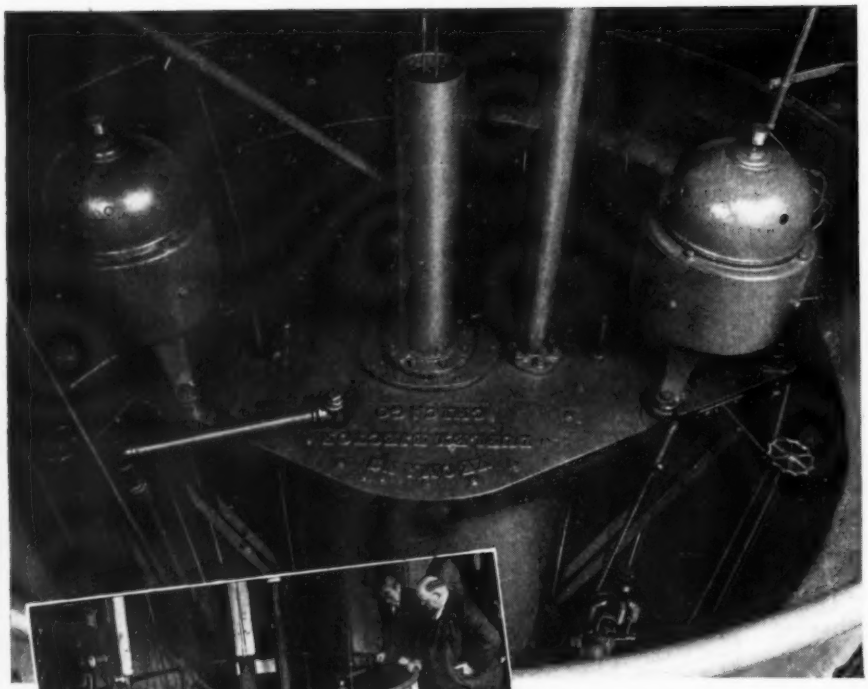

INSTALLED IN 1903

and Still Going Strong

Yeomans Duplex Sewage Ejector, installed when Chicago's LaSalle Street Station was built, functions efficiently after 42 years.

HERE'S another distinguished Yeomans veteran—an example of equipment whose quiet, capable tending to business is taken for granted. The unit consists of the sewage receiver, a Yeomans centrifugal pump on each side at the pit-bottom, and a motor for each pump. Its maintenance record since Russell Miller, chief engineer, took charge in 1937, is as follows:

- SLEEVE BEARINGS REPLACED
- TURNED COMMUTATOR ON ONE MOTOR
- PERIODIC INSPECTION AND LUBRICATION

You can expect that kind of performance from Yeomans products, for this reason: it is designed and built into them.

In the inset photo Mr. Miller is inspecting the equipment along with William Fergus, consulting engineer, who laid out the plant and supervised its installation back in 1903. He is still interested in the equipment, for the LaSalle street station is one of the few installations left in Chicago where the power plant generates its own power and electricity—and it was his first big job.

Bulletins 6201 and 2401 give you all needed performance and installation data on Yeomans Dry-Pit Sewage Pumps. Use the coupon.

Yeomans PUMPS

YEOMANS BROTHERS COMPANY, 1446 N. Dayton St., Chicago 22, Ill.

Please send more information on Yeomans Dry-Pit Sewage Pumps.

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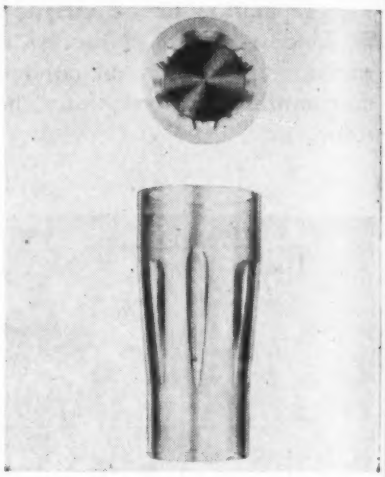
taining eight standards (0, 0.5, 1, 2, 4, 6, 8, 10 ppm) two comparison tubes, funnel, filter paper, graduate, flask and reagents. All equipment is contained in wooden carrying case. *W A Taylor & Co, 7300 York Rd, Baltimore 4, Md.*

Air-Filter Cleaner

NEW PROCESS chemically cleans all air filters, including air-conditioning, engine, marine and aircraft units. Remove filter and immerse for six minutes in a tank of cold Turco *Aktiv*, four oz to a gallon of water. Then remove filter from tank and give it a cold-water hosing to flush away dirt and grease. Dry in a stream of compressed air and dip into manufacturer's specified oil. Entire process is said to take less than 13 min. Process does not attack galvanized iron and clean filter is left odorless. *Turco Products, Inc, 6135 S Central Ave, Los Angeles 1, Calif.*



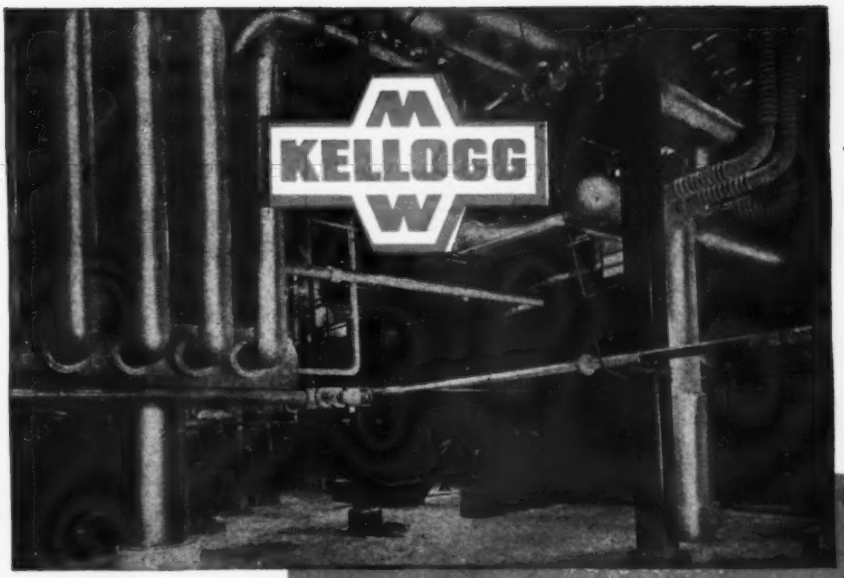
Rotameter Tube

BEAD-GUIDE TUBE, made of boro-silicate glass, simplifies rotameter construction because it eliminates center guide wire for stabilizing float. Three straight glass ribs run up inside tube to guide rotometer float throughout its travel. It solves problem of how to guide float when corrosive chemicals, such as hydrochloric acid, are being measured. There is only a hairline contact between float and each raised rib. These three ribs also give tube increased strength. New tube can be adapted to existing rotameters. *Fischer & Porter Co, 934 County Line Rd, Hatboro, Pa.*

Panel Instruments

TWO NEW 1½-IN. ELECTRIC indicating panel instruments are available: a watertight design for application where equipment may be accidentally submerged in water, exposed to rain or extremely humid climate, and a conventional design for aircraft or for other service where instrument will be protected from the elements.

Watertight instruments are known as Types DN-1, DN-2 and DN-3, while the conventional are DN-4, DN-5 and DN-6. Both instruments have the same basic design, utilizing an internal-pivot element



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The benefits of this comprehensive service are available to public utility, consulting, process and marine engineers. On your next difficult piping job, consult a KELLOGG engineer.

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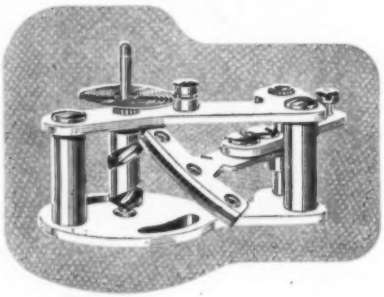

If you have pressure gauges which are subject to sudden shocks on releases of pressure, then Certified are the gauges for you. On hydraulic presses, the sudden release of pressure just about ruins the ordinary gauge with geared teeth.

But with Certified Gauges, a sudden release of pressure merely releases the cam from the Helicoid movement roller and that's that. No harm can come to the gauge. The force of the pointer against the stop pin is only that exerted by the hair spring. You get the same protection if your pressure gauges are subjected to vacuum as on turbine and condenser service. This is possible only with the Helicoid movement. And the Helicoid movement is used only in Certified Gauges.

All Certified Gauges are guaranteed accurate to within ½ of 1% of the scale range. They remain accurate longer.

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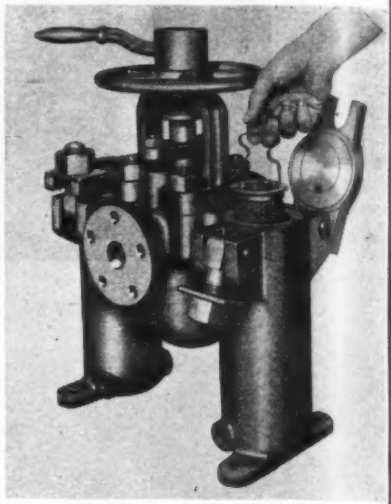
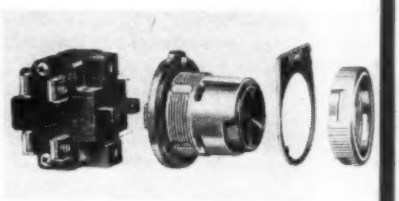
combined with permanent-magnet moving-coil construction. Pivots are solidly mounted on inside of armature shell, instead of being secured to outside of armature winding. Instruments are available in nearly all ratings for dc radio-frequency and audio-frequency measurements and are mostly for use with external thermocouples or rectifiers. *General Electric Co, Schenectady 5, N. Y.*



Plug-Cock Strainer

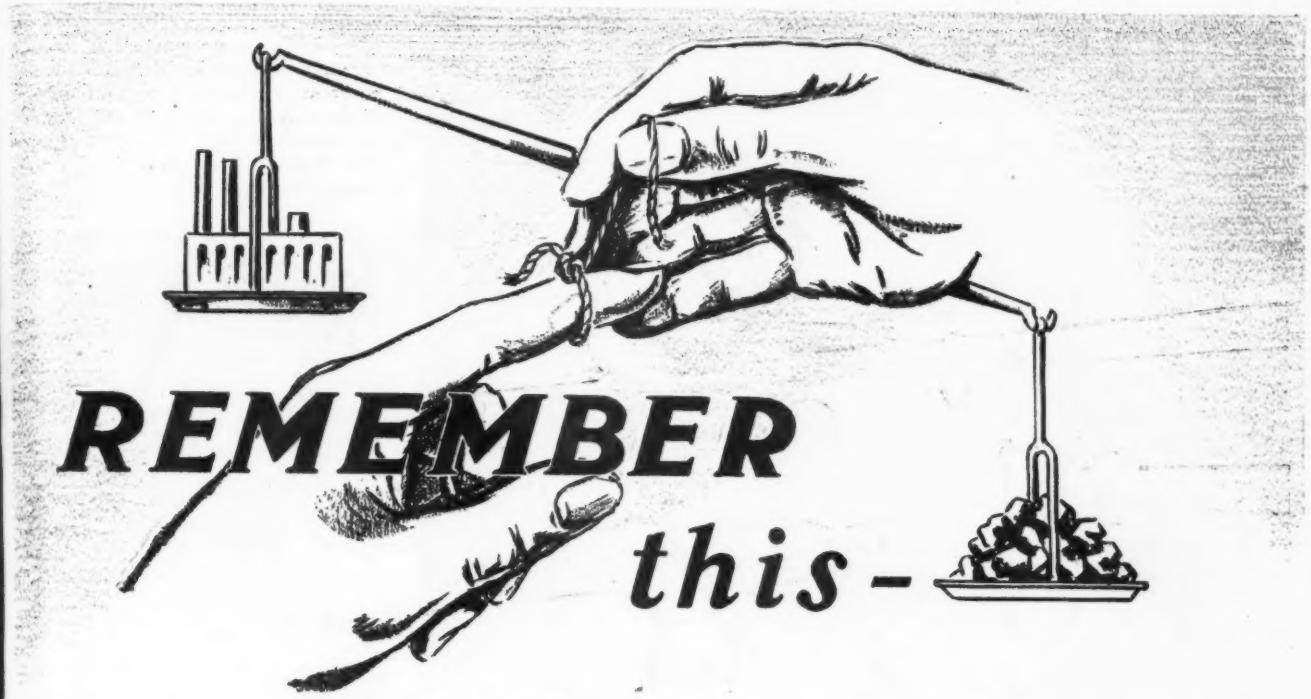
Addition to plug-cock strainer line is of twin design, one side being always in service while the other is cut out of service for cleaning strainer basket. The change from one chamber to the other is made by moving handwheel to loosen tight fit of plug, then shifting lever. An arrow on valve lever shows which compartment of strainer is in service. Valve lever also serves as a wrench to loosen door-bolt nut. With bolt swung down and door turned back, strainer basket is removed easily for cleaning. Arrows on handwheel clearly indicate how to turn it to loosen or tighten plug. Designed for either oil or water and for suction or discharge service, new plug-cock strainer is available in steel, cast iron or bronze. *Elliott Co, Jeannette, Pa.*



Oiltight Pushbuttons

Class 9001 Type T pushbuttons are for group mounting on machinery or control enclosures. Oiltightness is the principal feature of this new line. Although units are compact, there has been no sacrifice of accessibility. All terminal screws may be reached with a screw driver without going in at an angle.

Quick, easy installation is another advantage. As shown above, unit is inserted through panel and prevented from turning by a dowel. After legend plate is slipped on, thread ring firmly clamps unit into posi-



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Modernization for many plants is a "must," if steam generation is to meet tomorrow's standards of efficiency and economy.

By making proper investment of the equipment dollar, coal dollar savings are assured for the life of the plant.

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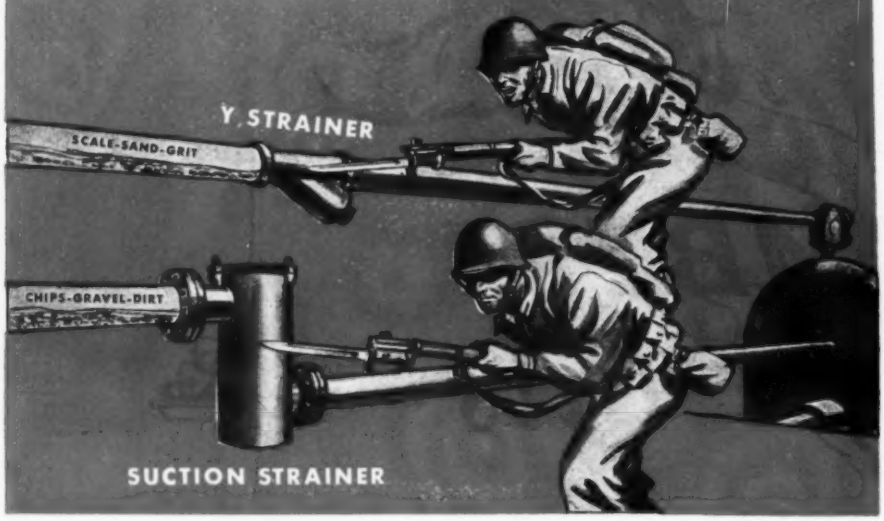
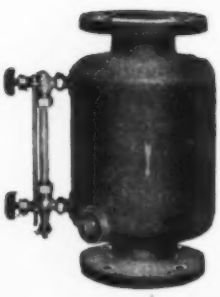


Prevent shutdowns — prolong the life of equipment — increase steam efficiency with ADSCO Strainers and Separators.

The Y Strainer **has a screen that is held in place by a removable plug that permits easy removal for cleaning. It protects traps, regulators, valves and other equipment from the wearing and destructive action of foreign matter.**

The Suction Strainer **does likewise for pumps and other heavier equipment where bulk liquid is contaminated with foreign matter.**

Nor shall moist steam lower the efficiency of your steam consuming equipment



ADSCO SEPARATORS

Remove oil and water from steam—increase its efficiency by delivering it dry.

***Right*—Horizontal Type**

***Left*—Vertical Type for either up flow or down flow.**

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PROTECT VALUABLE EQUIPMENT ... INCREASE STEAM EFFICIENCY WITH ADSCO STRAINERS and SEPARATORS

AMERICAN DISTRICT STEAM COMPANY

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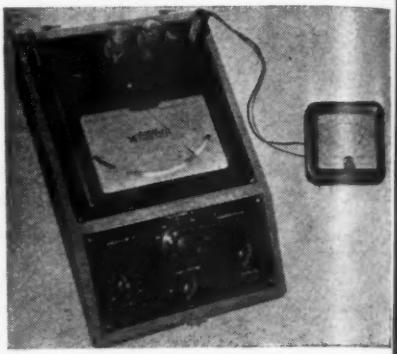
Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

tion. As operating mechanism and contact block are separate units, it is possible to obtain a combination to cover a wide range of circuit requirements with a limited stock of three kinds of operators and four models of contact blocks. *Industrial Controller Div, Square D Co, 4041 N Richards St, Milwaukee 12, Wis.*



Meter Tester

A MULTIRANGE DEVICE with self-contained regulated power supply and control equipment for 110-v ac current, 60 cycles, meter tester is composed of a stepless vacuum-tube voltage control, a large 8½ in. mirror-scale standard instrument and wire-wound resistors. Range of unit is 25 microamperes full scale to 10 milliamperes or 0 to 100-v full scale. *Marion Electrical Instrument Co, Manchester, N. H.*

Wire Rope

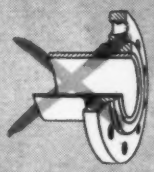
GREEN-COLORED LUBRICANT covers entire wire rope. Only highest-grade rope (pre-formed of improved plow steel) will be lubricated this way. Company's non-pre-formed ropes, made of improved plow steel, will continue to be identified by a single green strand. *Green-Lube* has high vis-cosity and capacity for adhesion to wire surfaces. It has a grease-like consistency at normal temperatures and is applied hot and in a molten state by pressure method which not only assures complete coverage of every wire but filling or stuffing of voids between wires. *American Chain & Cable Co, Bridgeport, Conn.*

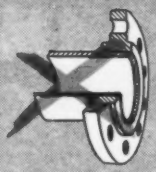
Paper-Dielectric Capacitors

HERMETICALLY SEALED, fixed paper-dielectric capacitors with glass terminal insulators in case styles CP-60, -62 and -64, characteristics E and F, meet requirements of Proposed Joint Army-Navy Specification JAN-C-25. Glass terminal seals provide a high degree of resistance to humidity, fungus growths and termites. They are of a unique construction which does not rely on matched coefficients of expansion of glass and metal

WHEN YOU NEED Lap-Joint Stub Ends

LAP-JOINT STUB END


SCREWED AND WELDED FLANGE


SLIP-ON WELDING FLANGE

WELDING NECK FLANGE

Whenever a flanged joint is required, the lap-joint stub end has a great advantage over flanges welded to the pipe. The swivel flange makes it unnecessary to accurately line up the bolt holes before welding; "setting up" is simple and quick because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. The result is a real saving in time and cost of welding. Field crews report a saving of 25% in erection time for making up a joint using Midwest Lap-Joint Stub Ends in comparison with flanges rigidly fixed to the pipe.

Specify MIDWEST FOR THESE REASONS

FORGED LAP—by special Midwest process that simultaneously upsets pipe and forms lap. Tests prove superiority of process.

LARGE RADIUS FILLET—More metal, hence greater strength, in the critical area of lap where maximum total bending and shearing stresses occur.

HEAVY LAP—After machining front and back, lap is always at least equal to pipe wall thickness.

STRESS RELIEVED—Metal in lap is worked at forging heat, then normalized to assure uniform, close grained structure. Photo-micrographs frequently show it to be superior to original pipe metal.

SQUARE CORNER—(instead of a round corner) adds to lap strength and eliminates pock-ets for accumulation of con-densate and sediment which promote corrosion.

MACHINE BEVELED—welding end is accurately machined for easy welding.

PHONOGRAPHIC FINISH—of lap face to hold gasket more securely.

UNIFORM FLANGE BEARING—Back face of lap carefully machined to assure uniform flange bearing nec-essary to satisfactory joint.

TIME SAVED—In welding and erection because bolt holes need not be carefully lined up before welding.

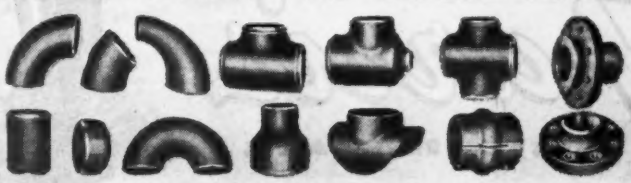
MIDWEST

PIPING & SUPPLY COMPANY, INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Sales Offices: New York 7—(Eastern Division) 30 Church St., Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St. • Distributors in Many Cities

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



FARRIS

PRECISION ALIGNMENT

ON GUARD *always!*

FARRIS SAFETY VALVE TYPE 2350—Economical first cost and maintenance. Full inlet port. Meets ASME code. Flanged or screwed outlets. Semi-steel 250 lb.; cast steel, 600 lb. Bronze ½" to 2". Steel or semi-steel 2" to 6"

Exclusive with FARRIS Relief and Safety Valves, "Precision Alignment" is an engineering achievement of improved valve design. It required the development of special techniques for fixtures, tooling, and precision machining. That hard-hitting combination results in unprecedented close tolerances in the alignment of spring, stem, disc, guide, and seat . . . precision operation. *On Guard — always!*

With FARRIS "Precision Alignment," 100% of the valve spring effort is exerted directly upon the pressure to be controlled. No spring power is dissipated in drag caused by angular distortion. Super-accuracy and dependable control of pressure-relief is thereby secured . . . *On Guard—always!*

Minimum blow-down is accomplished by quick, precision-tight reseating of the disc on the seat after over-pressure has been relieved to normal pressure. Remember, minimum loss of pressure from relief action assures economical, uninterrupted operation of your plant.

Exclusive with FARRIS, precision alignment is* On Guard—always . . . *with added safety and protection for your equipment from over-pressure dangers. FARRIS Relief and Safety Valves are dependable. They give maintenance-free and economical operation. They are built for long-life service. Specify FARRIS—and you're safe—ALWAYS!

Write today for our Specifications Bulletin

FARRIS DIAPHRAGM RELIEF VALVE TYPE 1000—All bronze construction, meets Navy Spec. 45V26. No packing gland; for back pressures. Relieves capacity at 20% over-pressure. For water, oil, steam, air, pressures to 150 lb. Sizes ½" to 2".

Farris

SAFETY and RELIEF VALVES

FARRIS ENGINEERING CO., 366 Commercial Ave., Palisades Park, N. J.

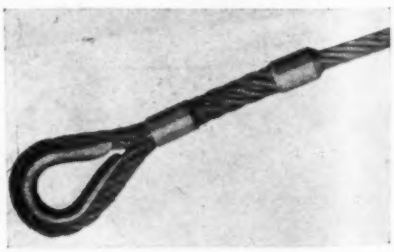
to resist thermal shock or on soft solder for mechanical strength.

Three case styles are available in all proposed JAN-C-25 ratings, in both single-section and two-section construction. Capacitance values range from 0.05 to 0.50 microfarad, for voltages of 600, 1000 or 1500 v. *General Electric Co, Schenectady 5, N. Y.*

Voltammeter

SIMULTANEOUS READINGS of current and voltage are taken with Model 601 voltammeter. Sturdy compact case contains an ac voltmeter and an ac ammeter. The ammeter (at right) measures from 0.2 to 500 amp in eight current ranges: 1, 5, 10, 25, 50, 100, 250 and 500 amp. Voltmeter (at left) measures from 30 to 600 v in three ranges: 150, 300 and 600 v. Voltmeter can also be used on dc at these ranges.

An inserted primary-current transformer with 8-ft secondary leads facilitates current measurement on 100-, 250- and 500-amp scales without subjecting the meter to stray magnetic fields. User can locate the meter where it can be read easily, regardless of current transformer's location. Range selector switch on panel permits quick reading of currents in all eight ranges. Strong metal case has a stout carrying strap. *Associated Research, Inc, 231 S Green St, Chicago 7, Ill.*

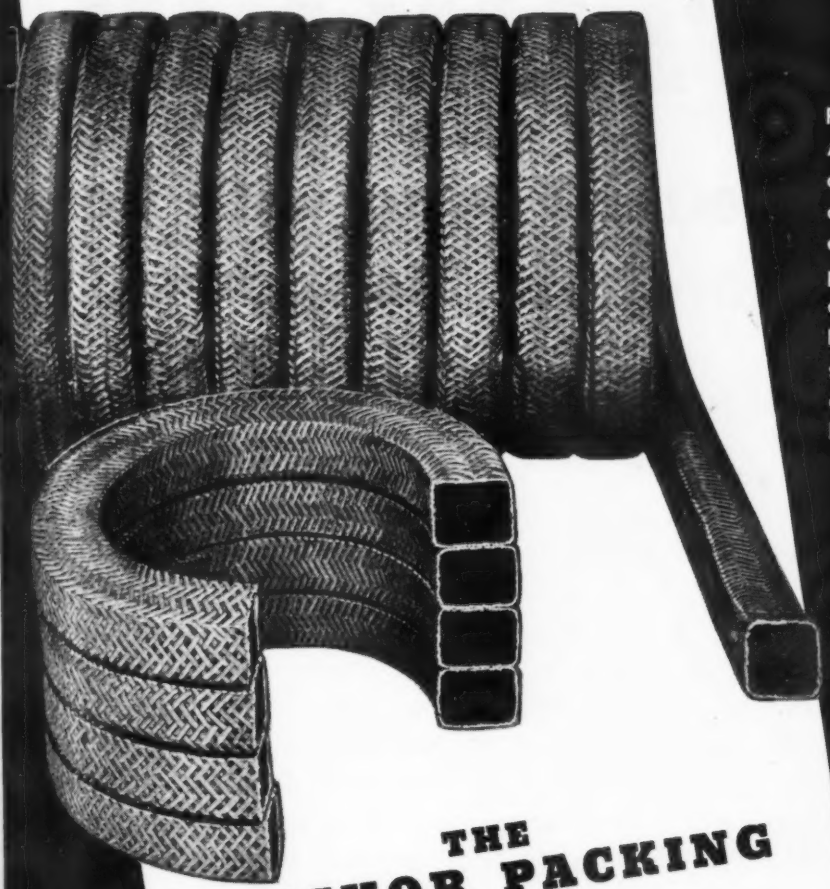


Safety Splice

NEW METHOD for splicing wire rope into slings or various assemblies has been developed. The splice is flexible to the terminal and is said to develop 100% of the rope's strength. Safety splice does not distort rope structure and therefore maintains equalization of stresses in all strands. Splice applies load stress in direct line with load pull. It has no seizing to loosen, unravel or get in the way; no wire ends to barb and tear workmen's hands. It is wide open for visual inspection at all

ANKORITE
No 858 CWB . . .

A Good Number to Remember



WHEN PACKING TROUBLES OCCUR

PLASTIC CORE COPPER BRAID No. 858-CWB

A plastic core packing made from lubricated long fiber asbestos graphite mixture containing soft metal particles and encased in a copper jacket. This style of packing is useful on rods and plungers operating against steam, hot oil, or for high temperature valve stems and expansion joints. It may be used alone or in combination. Spirals are 10 feet in length. Sizes ¼" to 1¼".

RECOMMENDED USES:

Steam
•
Air
•
Expansion Joints
•
Valve Stems, Etc.
Rotary and Reciprocating
•
750° F
Pressures to 1500 PSI
•
A Good Packing
for
Hydrofluoric Acid

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA 8, PA.

FACTORIES

MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

BRANCH OFFICES

Baltimore 2, Maryland	106 Stewart Building Gay and Lombard Streets
Boston 14, Massachusetts	303-04 North Station Building 150 Causeway Street
Buffalo 2, New York	Andrews Building
Cleveland 13, Ohio	523-25-27 Rockefeller Building
Columbus 9, Ohio	174 North Cassingham Road
Chicago 11, Illinois	200 East Illinois Street
Cincinnati 2, Ohio	4 West 7th Street
Detroit 26, Michigan	169 West Jefferson Avenue
Houston 2, Texas	509 Washington Avenue
Indianapolis 5, Indiana	5225 Woodside Drive
Kansas City 6, Missouri	1332 Oak Street
Los Angeles 21, California	720 Mateo Street
Montreal, Canada	5575 Cote Saint Paul Road
Milwaukee 2, Wisconsin	4417 West North Avenue
New Orleans 4, Louisiana	418 Common Street
New York 13, New York	100 Sixth Avenue, near Canal
Philadelphia 8, Pennsylvania	401 North Broad Street
Pittsburgh 22, Pennsylvania	405 Penn Avenue
Portland 5, Oregon	Terminal Sales Building
San Francisco 7, California	156 South Park
Seattle 4, Washington	2207 First Avenue, South
St. Louis 3, Missouri	1407 Pine Street
Tulsa 4, Oklahoma	823 South Gary Place
Wilmington, California	207 Avalon Boulevard

IRON FIREMAN POWERAM STOKERS

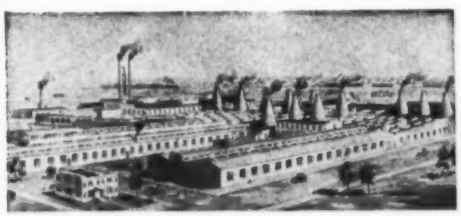
–Better Firing with Less Fuel and Manpower

Highly Efficient Combustion under Automatic Control results in Fuel & Labor Savings

COAL is automatically fed into the furnace in the exact amount needed, no matter how much the load may change. However, supplying the right volume of air for efficient combustion is complicated by the condition of the fuel bed, which is an ever changing factor. When the fuel bed is deep, more pressure is required to force the proper amount of air through the fire. With a shallow fuel bed less air pressure is needed. The Iron Fireman Volumeter, one of many features reflecting Iron Fireman's advanced engineering, performs this sensitive and continuous regulation of the air supply. It is instantly responsive to the condition of the fuel bed and meters the air accordingly.

Efficient combustion, which cuts fuel tonnage, is only one source of Iron Fireman economy. Further savings result from the use of a lower priced coal than could be successfully used in hand-firing. Iron Fireman saves manpower, too. All models are under full automatic control and require little attention. Coal-Flow models feed directly from the main coal bunker to the boiler.

CAN YOU AFFORD TO WASTE WHAT IRON FIREMAN USERS ARE SAVING?

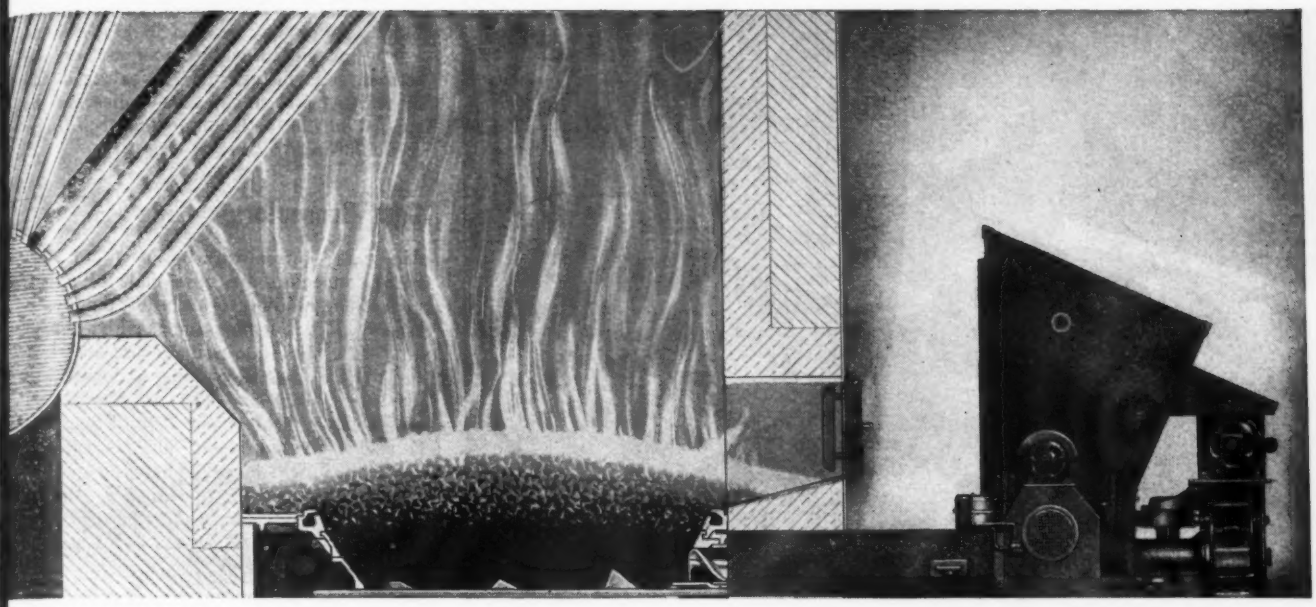


LIMOGES CHINA COMPANY, *Sebring, Ohio.* Fuel costs in this plant were reduced $2,448 annually with Iron Fireman firing. Steam is used for power, processing and heating. Increased demand for their product resulted in installation of a second Iron Fireman stoker.

VICK CHEMICAL COMPANY, *Philadelphia, Pa.* In addition to meeting rapidly changing steam requirements, Iron Fireman stokers have cut fuel costs drastically over former method of firing, thus reducing coal tonnage.

NATIONAL TRANSIT CO., *Bear Creek Pumping Station, Parker's Landing, Pa.* Nine Iron Fireman Poweram stokers maintain steady steam pressure, under heavy load conditions, 24 hours a day, 7 days a week.

IRON FIREMAN

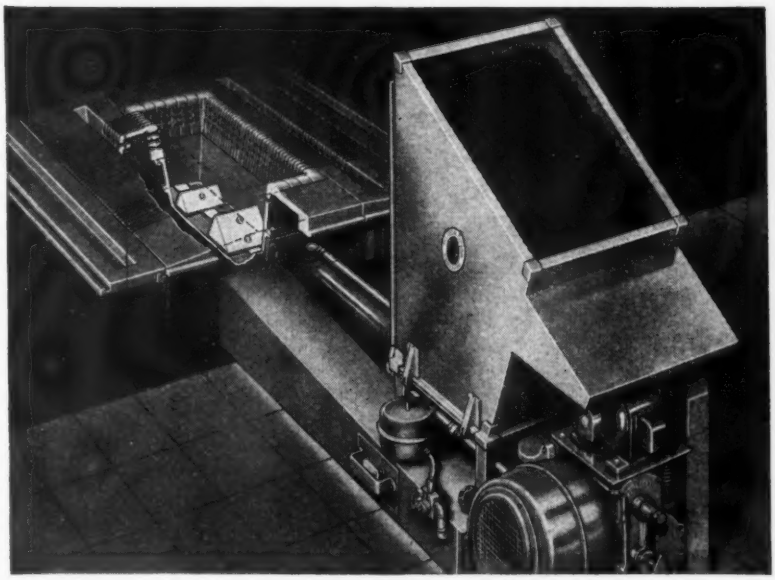


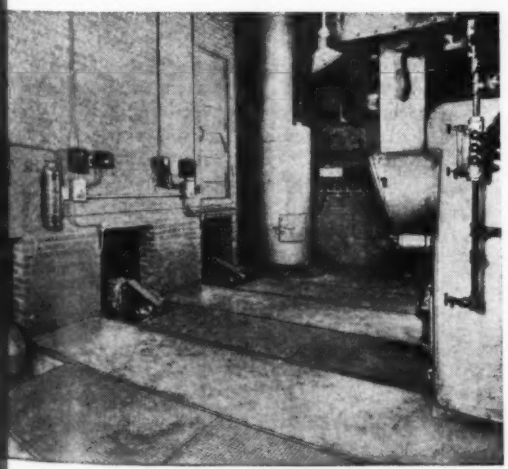
THE IRON FIREMAN POWERAM

A Heavy Duty Stoker for Boilers up to 500 h.p.

The sectional view of the Iron Fireman Poweram, above, explains the merits of the Iron Fireman underfeed fire, in which new fuel is introduced below the fire bed. As the coal rises in the retort and its temperature gradually reaches the combustion point, the more volatile elements are distilled off. They do not escape unburned, for they must pass through the fuel bed. No wasteful, smoky fire.

Coal is conveyed from the hopper or bunker by a worm conveyor, which does not compress the coal, but delivers it to the retort in a loose and aerated condition. Reciprocating pusher blocks in the base of the retort distribute the coal without packing. This combination of worm conveying and ram distribution is an exclusive Poweram feature.





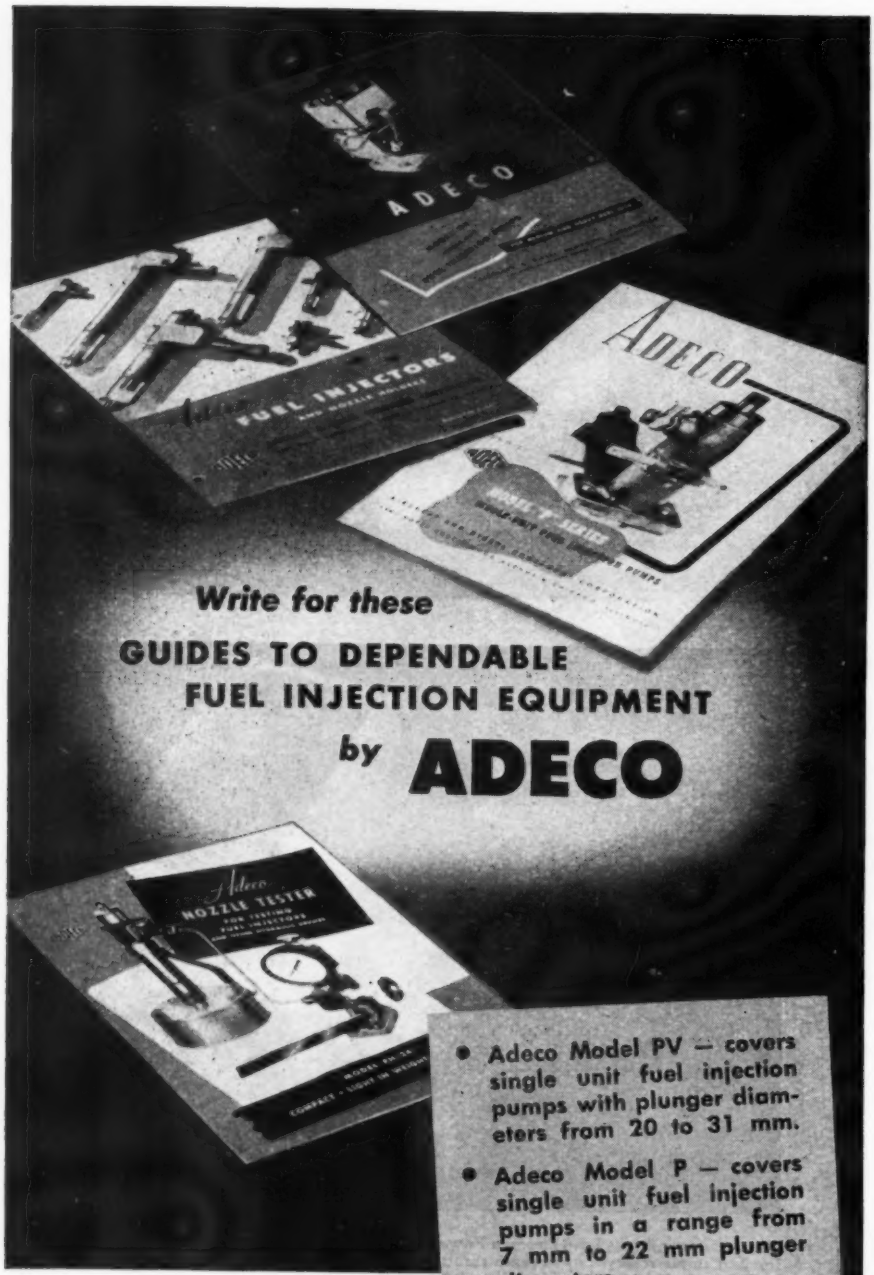
Above: Hopper model Iron Fireman Poweram Stoker. Precision manufacture, sound engineering and ample reserves of strength result in extremely low maintenance costs. *Left:* Multiple boilers served by heavy duty Iron Fireman Coal-Flow Stokers. In this installation the conveyor worms are housed under the floor plates.

THERE IS AN IRON FIREMAN FOR EVERY FIRING NEED. Iron Fireman stokers are available in many sizes and models to meet the most varied commercial and industrial requirements. Iron Fireman engineering assures you the correct stoker for your plant, taking into account fuel, load and operating conditions.

YOU CAN HAVE A FREE ENGINEERING SURVEY OF YOUR BOILER ROOM. A free engineering survey will give you valuable information about your own boiler plant, and recommendations for improvements where needed. Call your local Iron Fireman dealer for survey or catalog, or write to Iron Fireman Manufacturing Company, 3843 West 106th Street Cleveland 11, Ohio.

AUTOMATIC
COAL STOKERS

Iron Fireman Commercial and Industrial models fire boilers up to 1000 h. p. and larger



- Adeco Model PV — covers single unit fuel injection pumps with plunger diameters from 20 to 31 mm.
- Adeco Model P — covers single unit fuel injection pumps in a range from 7 mm to 22 mm plunger diameters.
- Adeco Fuel Injectors—presents the complete line of Adeco standard injectors and nozzle holders, including water-cooled type.
- Adeco Nozzle Tester—brings the complete story on this widely-used portable equipment for testing fuel injectors and hydraulic devices.

If you do not already have these helpful bulletins on Adeco fuel injection equipment, you can get them for the asking. The informative bulletins listed here present details on today's line of Adeco fuel injection pumps, nozzles, nozzle holders and nozzle testers.

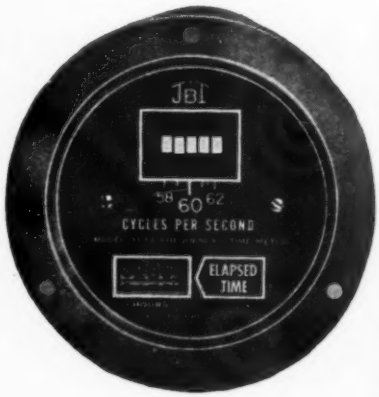
Write for them by name, or if you prefer, ask for complete catalog.

ADECO
AIRCRAFT & DIESEL EQUIPMENT CORP.
4401 NO. RAVENSWOOD AVE. • CHICAGO 40, ILLINOIS

times. Splice may be used with any standard fitting and, when sling or assembly is retired, such fittings may be salvaged and reused. At present time new splice may be applied only at the factory. *American Chain & Cable Co, Bridgeport, Conn.*

Cast Connectors

ALL CAST, current-carrying parts of electrical connectors are now made of a new high-strength alloy. This alloy, known as Burndy 113L, is the same as high-copper alloy 113, with addition of lithium. This addition is said to provide a denser and fine-grained casting, with an increase in tensile strength of almost 20%. Elongation is also increased about 20%. Coefficient of friction is reduced. These advantages are obtained, according to maker, without any appreciable change in electrical conductivity. *Burndy Engrg Co, 107 Bruckner Blvd, New York 54, N. Y.*



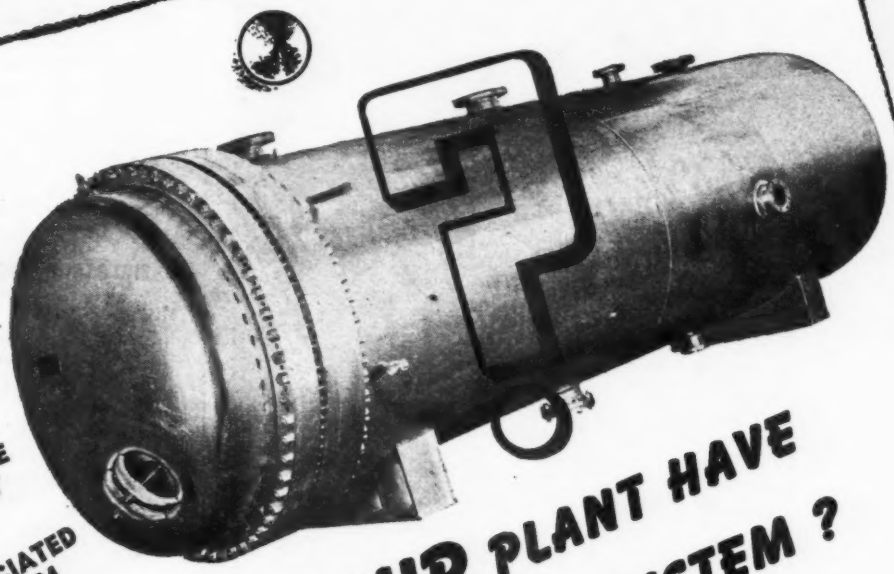
Indicating Instrument

NEW ELECTRICAL indicating instrument combines frequency meter and elapsed-time meter in one case. This combination saves both panel space and weight. It is used on engine-driven generator sets and other equipment where proper operating speeds, lubricating and overhaul schedules are important considerations. Frequency or speed is indicated to an accuracy of ±0.3%, according to manufacturer, by a bank of five reeds calibrated in single cycle steps from 58 to 62 cycles. Running-time meter is driven by a synchronous motor and indicates elapsed time in hours and tenths.

Designated as Model 31-FE, this meter operates on 110 v and is also available for 48 to 52 cycles and in half cycle steps from 59 to 61 and 49 to 51 cycles. Other ranges are under development. *J-B-T Instruments, Inc, New Haven, Conn.*

Expansive Bit

TOOL BORES HOLES in hard or soft wood. Center lip, which cuts away core at center of hole, extends back to form a clamp which firmly holds adjustable blade at diameter set. Clamp is locked tight by a screw. Diamond-shaped extra-long and finely threaded screw point is said to assure longer life by lessening chance of breakage. Screw also helps to pull bit entirely through the work because it is con-



REDUCING VALVE TYPE

SINGLE EFFECT

MULTIPLE EFFECT

ASSOCIATED SYSTEM

SHOULD YOUR PLANT HAVE AN EVAPORATOR SYSTEM ?

ONE OF A SERIES OF ADVERTISEMENTS DESCRIBING THE MANY TYPES OF G-R HEAT TRANSFER APPARATUS

The fact that one or more of your neighboring plants do or do not have an evaporator system for distilling their boiler feed make-up may not be a safe guide for you to follow—even if these plants seem to be similar to your own.

Operating conditions, steam demands, quality of raw water supply and plant heat balance—all are factors in determining the advisability of an evaporator installation. These factors are distinctive in each plant and require individual study. Griscom-Russell brings to such a study the accumulated experience of 77 years of pioneering in the development and application of evaporator systems, and the results obtained in many hundreds of evaporator installations.

These are some of the reasons why Griscom-Russell recommendations are authoritative, and why you can depend upon their advice as to the advisability of an evaporator system for your particular plant conditions. Write for complete information, without obligation.

G-R BUILDS ALL THESE UNITS FOR HEAT TRANSFER SERVICE . . .

- Evaporators
- Stage Heaters
- Gas Coolers
- Drain Coolers
- Aftercoolers
- Air Preheaters
- Fuel Oil Heaters
- Jacket Water Coolers
- Process Heat Exchangers
- Transformer Oil Coolers
- Generator Air Coolers
- Lubricating Oil Coolers
- Storage Tank Oil Heaters

THE GRISCOM-RUSSELL CO.

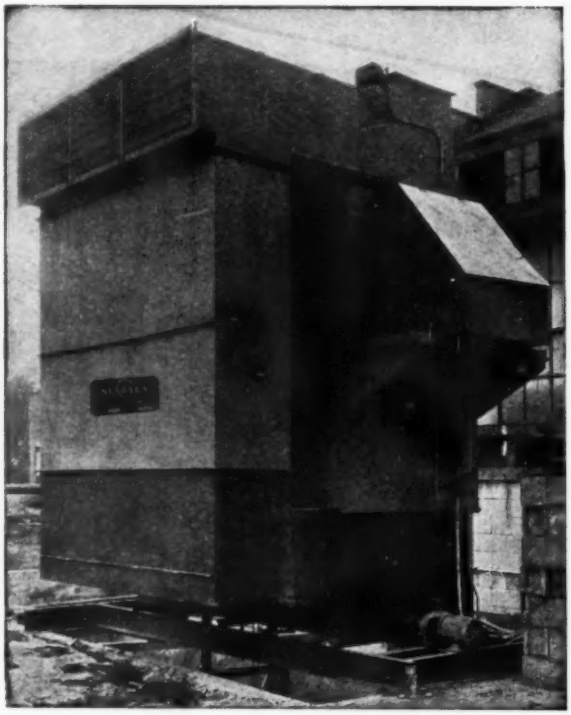
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

"BALANCED WET BULB" TEMPERATURE CONTROL

U. S. Patent Re-issue No. 22,333



Don't PURCHASE COOLING WATER!

● Whenever a process calls for the use of water to cool liquids or gases, investigate using the NIAGARA Aero HEAT EXCHANGER to gain these benefits:

1. Year 'round operation at full efficiency.
2. Reliable temperature control within 2°F.
3. Elimination of water treatment.
4. Saving 95% of water consumption.
5. Avoiding risk of shutdown in time of water shortage.
6. Saving piping, pumping and power and equipment costs.

The NIAGARA Aero HEAT EXCHANGER, using outdoor air as the cooling medium with the evaporative method, removes 1,000 B. T. U. from a liquid for each pound of water evaporated. Accurate temperature control within 2°F. is assured by the Niagara patented "Balanced Wet Bulb" control which always provides the correct admixture of fresh and recirculated air. Hundreds of industrial plants, operating a wide variety of processes, have found it the most reliable, most compact and economical apparatus for liquid cooling. Write for Bulletin 96.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. P-75, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

tinually engaged while adjustable blade is cutting. Regardless of diameter of hole, whether through thin or thick material, only light pressure is needed to cut quickly and evenly.

Expansive bit has long and short cutting blade. Graduated scale on blade makes adjustment easy. This is in addition to fixed cutter or center lip.

Two models are available: No. 200-B cuts holes from ¾ to 1¾ in. It is 7 in. long. No. 201-B cuts all diameters from 1½ to 3½ in. and is 8½ in. long. *Bruno Tools, 9330 Santa Monica Blvd, Beverly Hills, Calif.*

Compressor Head

MOCUL COMPRESSOR HEAD Model 105 is designed for Model A or B Ford motor block. Head delivers a volume of 139 cfm, with an actual delivery of 100 cfm at 100 psi. Complete unit includes valve and water chambers, air intake manifold, air strainer, unloader, pilot valve and necessary parts for assembly. Complete instructions come with each unit. *Metallizing Co of America, 1330 W Congress St, Chicago 7, Ill.*

Rust Remover

TROXIDE, a new pickling agent, removes rust, scale, tarnish and incrustations of cement and lime from metals. This dry inert compound throws off no acid-mist or other toxic fumes which are pungent, corrosive and harmful to workmen and machinery. *Troxide*, packed in wooden barrels, may be used either hot or cold. *Waverly Petroleum Products Co, Drexel Bldg, Philadelphia 6, Pa.*

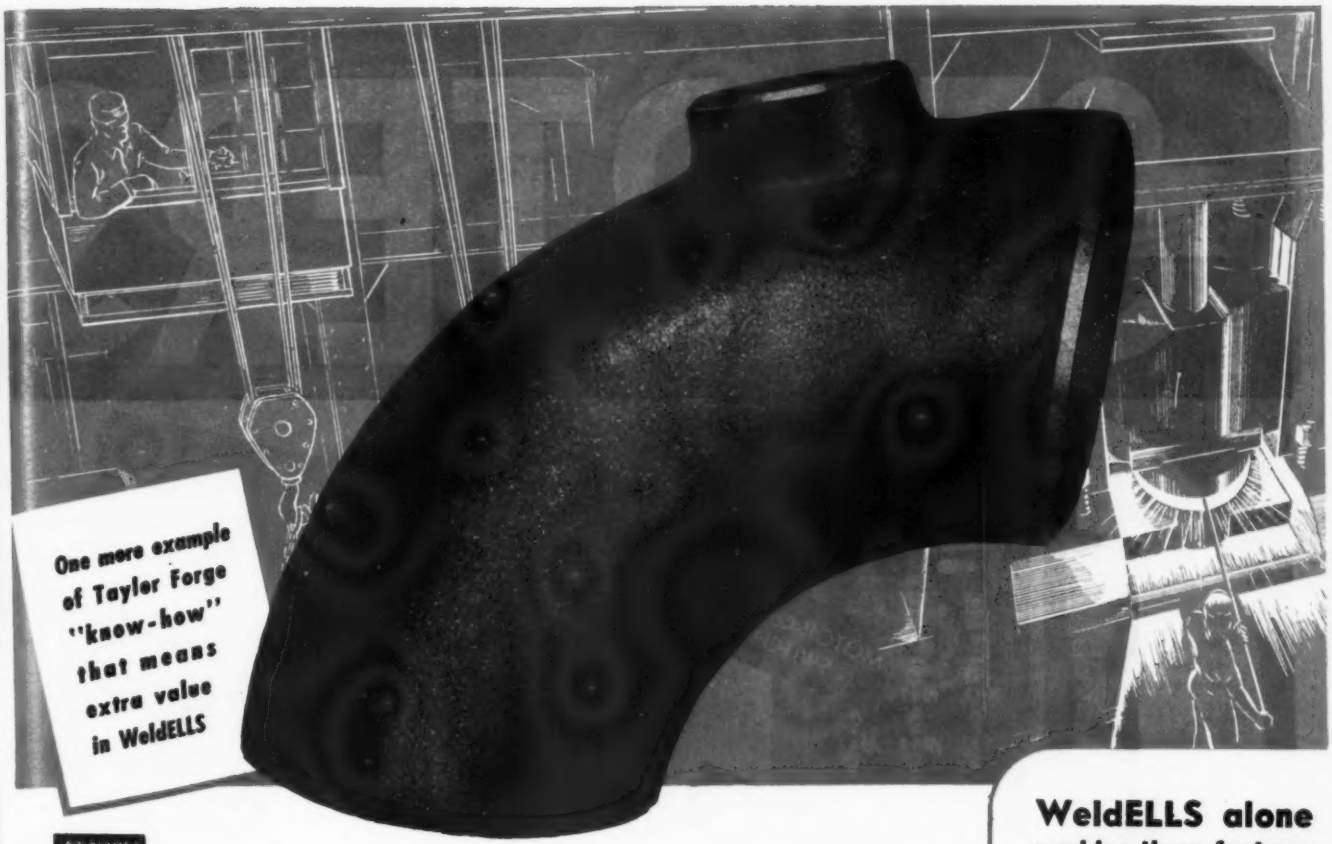
Floor-Cleaning Products

SPEEDI-DRI AND SOL-SPEEDI-DRI prevent slipping accidents and fires caused by oil-soaked floors. They absorb grease and oil from any floor. Repeated spreading removes build-up stains and restores floor to its original color. Regular *Speedi-Dri* is for use only on mineral oils. *Sol-Speedi-Dri* soaks up soluble oils, oil and water accumulations, paints, sirups, resins, etc. There are other applications for *Speedi-Dri*, such as saving belts, ropes and workers' shoes from rotting; drying heat-treated metal parts, oil-slippery tools; renovating gummed up files; cleaning oil-smeared hands and arms to avoid dermatitis; and extinguishing fires.

Neither Speedi-Dri nor Sol-Speedi-Dri burn readily even when oil soaked. They are also deodorants and increase light reflection. *Refiner's Lubricating Co, 601 W 26th St, New York 1, N. Y.*

Pipe-Joint Compound

PIPETITE-STIK, a pipe-joint compound, comes in handy, clean, easy-to-use stick form. Rub three or four strokes of stick across pipe threads. It spreads and fills threads when turned. Incased in a cardboard holder, stick may be carried around in pocket or tool kit. Compound lubricates and seals pipe-joint threads, nuts, bolts, gaskets, turnbuckles, etc. *Lake Chemical Co, 607 N Western Ave, Chicago 12, Ill.*



There's always another one for us!

★ *Just when we think we've seen everything in special forged fittings another tricky requirement turns up . . . and probably always will. This time it's an order for seven-inch carbon-moly WeldELLS with integrally formed 3-inch outlets in their back walls.*

We have solved problems that are a lot tougher than this, but none exactly like it. Thus, like hundreds before it, it has contributed its share to the sum total of Taylor Forge "know-how" . . . is one more proof that we have honestly earned our reputation for doing things with hot metal no one else does.

THE unduplicated experience of Taylor Forge in the field of special forging has a vital bearing on your choice of standard welding fittings. It means there is nothing to be desired in welding fittings that is not within the scope of the methods and facilities that have grown out of this experience.

By applying these methods and facilities we have given WeldELLS features that are not combined in any other fittings. A good example of this is the uniform strength achieved through proper distribution of extra metal where stresses are higher. Another, is the extreme dimensional accuracy attained by special truing operations. Still another is the special process which forms the tangents, and there are many more.

This specialized Taylor Forge knowledge is responsible for the features listed opposite—is the reason why those who are best qualified to know will agree that

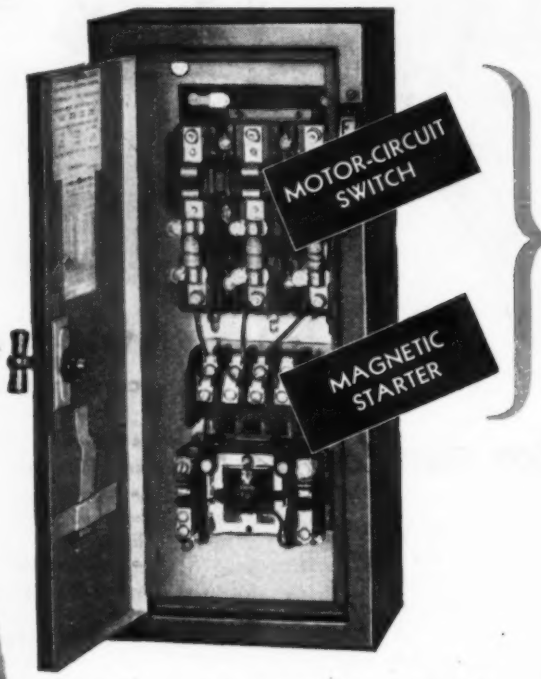
WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

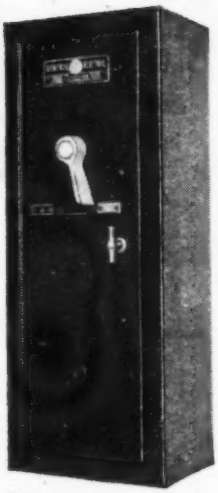
WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

MOTOR STARTERS



BOTH IN ONE UNIT



Showing door closed

USE COMBINATION STARTERS
to save time, save space, increase safety

Whatever your plant's operating conditions, you can get a combination control to fit it. This means a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one, compact, easy-to-mount unit.

Here are some of the advantages

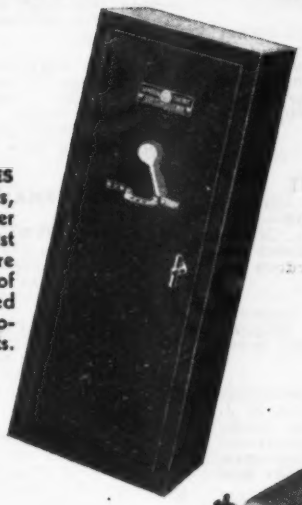
1. *50% reduction in mounting time*—You mount only one device, not two.
2. *40% reduction in wiring time*—Connect to only 9 terminals, not 15. The switch and starter come already connected.
3. *Increased safety*—Cover cannot be opened while there is power on the starter.
4. *Reliable motor protection*—Protection devices co-ordinated in starter at the factory.
5. *Saving of wall space*—The one device takes less space than two.
6. *Improved plant appearance*—Single, streamlined case—less open wiring and conduit.

GENERAL ELECTRIC

EVERY TYPE, EVERY KIND, FOR EVERY MACHINE APPLICATION

DEPENDABLE... ATTRACTIVE IN APPEARANCE... DESIGNED TO BLEND WITH MODERN MACHINES

DUST-TIGHT ENCLOSURES—For use in steel mills, cement mills, and other locations where the dust content of the atmosphere is heavy. The case is of heavy sheet metal, equipped with heavy gaskets, clamping bolts, and wing nuts.



GENERAL-PURPOSE STARTERS—Suitable for general-purpose, indoor applications where atmospheric conditions are normal.

WATERTIGHT ENCLOSURES—Suitable for outdoor use, and for damp places indoors, such as dairies, breweries, and ship docks. The case is of cast iron, or fabricated steel plate, with a special weatherproof finish and corrosion-proof fittings.

CORROSION-RESISTANT CONTROLLERS—Made in two forms—one for corrosive atmosphere and one for hazardous locations. All arcing parts and terminals (of forms for hazardous locations) are at least six inches under oil.

STARTERS FOR HAZARDOUS LOCATIONS—Made of cast, high-strength alloy. This starter is designed to withstand internal explosions. The flanges, which are securely bolted on all sides, are ground to tolerances which will not permit the escape of gases. General Electric Company, Schenectady 5, N. Y.

Which of these bulletins may we send you?

General Electric Company, Section J676-132,
Schenectady 5, New York.

Please send me the bulletins checked below.

- ☐ GEA-3715 General-purpose, dust-tight and watertight starters
- ☐ GEA-3541 Corrosion-resistant controllers
- ☐ GEA-3804 Starters for hazardous locations

Name.....

Company.....

Address.....

City.....State.....

8920

Buy all the BONDS you can—and keep all you buy

These NEW Catalogs, Booklets and Bulletins Are Yours for the Asking!

BOILERS AND AUXILIARIES

1 **SPREADER STOKER**—Detroit Stoker Co, General Motors Bldg, Detroit 2, Mich. 36-page catalog No. 60 presents the RotoGrate stoker, an advanced design of spreader stoker with forward-moving grates for large and medium boilers.

2 **STOKER PARTS** — Canton Stoker Corp, Canton, Ohio. 8-page manual gives photos and part names to identify quickly and accurately the needed unit for Vulcan and Lo-Set Ramfeed stokers.

3 **SPREADER STOKER**—Detroit Stoker Co, General Motors Bldg, Detroit 2, Mich. 32-page catalog No. 840 discusses the RotoStoker, in power dumping, hand dumping and stationary grate styles, for power field application under 100,000 lb of steam per hr.

ELECTRICAL EQUIPMENT

4 **EXPLOSIONPROOF MOTORS**—General Electric Co, Schenectady, N. Y. 28-page bulletin No. GEA-4131 covers explosionproof equipment for hazardous locations.

5 **RESISTOR UNITS** — Ward Leonard Electric Co, Mt. Vernon, N. Y. 32-page booklet describes Vitrohm resistors. Sizes and ratings are included.

6 **ELECTRONIC HEATING** — Scientific Electric, 107 Monroe St, Garfield, N. J. 16-page booklet gives historical background and development of electronic heating, explains principle of its operation and describes the two chief methods and fields of application.

7 **EMERGENCY LIGHTING** — Electric Cord Co, 50 Church St, New York 7, N. Y. 4-page catalog covers dry and wet battery emergency lighting equipment.

8 **ALNICO MAGNETS**—General Electric Co, Schenectady, N. Y. 20-page bulletin No. GEA-3682B points out applications, magnetic properties, mechanical properties and standard forms of sintered-alnico magnets.

9 **INDUCTION HEATING**—Ajax Electrothermic Corp, Ajax Park, Trenton 5, N. J. 12-page reprint, entitled "Induction Heating—A History of Its Development," tells how the induction furnace was started back in 1916 and reveals many early applications.

MAINTENANCE AND SAFETY EQUIPMENT

10 **OIL CLARIFIERS**—Briggs Clarifier Co, Washington 7, D. C. 36-page booklet describes G, F, DFR, DR and DRU series oil clarifiers and ZR series oil filters. Article entitled "Continuous Lube Oil Maintenance," by Walter C Bauer, is included in booklet.

11 **BELT VULCANIZERS**—B F Goodrich Co, Akron, Ohio. 4-page catalog section No. 2158 introduces electric vulcanizers for splicing and repairing of rubber belting.

12 **RUST PREVENTIVE** — Johnston & Jennings Co, 864 Addison Rd, Cleveland 14, Ohio. 12-page bulletin No. R-181 introduces Rusta Restor, an electrical method of preventing the rusting of steel tanks, piping and other steel structures.

MAINTENANCE MATERIALS

13 **SPIRAL-WOUND GASKETS**—U. S. Gasket Co, 1720 Pierce Ave, Camden, N. J. 4-page folder discusses construction and specification data for Ajax spiral-wound gaskets.

14 **PISTON PACKING**—Darling Valve & Mfg Co, Williamsport, Pa. 8-page bulletin No. 4502 presents Darcova Pumcups, an improved material for packing pistons of air and hydraulic cylinders.

15 **LEATHER PACKINGS**—Chicago Belting Co, Green & Washington St, Chicago 7, Ill. 64-page catalog contains sketches and comment on design and application of replacement packings.

16 **LUBRICANT**—Lubriplate Div, Fiske Brothers Refining Co, 129 Lockwood St., Newark 5, N. J. 28-page service handbook gives valuable information on Lubriplate lubricants.

17 **OIL ABSORBENT** — Refiners Lubricating Co, 601 W 26th St, New York 1, N. Y. 6-page folder describes how to keep your floors clean with Speedi-Dri and Sol-Speedi-Dri. Use Speedi-Dri on floors with mineral oil accumulations and Sol-Speedi-Dri for soluble oils and other liquids.

18 **PROTECTIVE MATERIALS** — Saverite Engrg Co, 1029 Clinton St, Hoboken, N. J. Folder contains seven leaflets on Saverite products, including refractory coating, Serviron, sludge solvent, boiler water and metal treatment, steam eliminator, Eureka and steam line corrosion treatment.

MECHANICAL TRANSMISSION

19 **OPEN-END V-BELTING**—B F Goodrich Co, Akron, Ohio. Catalog section No. 2186 gives rules for successful application of open-end V-belting, including method to determine pitch length, allowances for fastener length and for tension.

20 **SPEED REDUCERS** — Philadelphia Gear Works, Inc, Erie Ave & G St, Philadelphia 34, Pa. 52-page catalog No. MR45 describes line of self-contained motorized speed reducing units.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead giving writer's name and title.

★ **FRICTION MATERIALS**—Manhattan Rubber Mfg Div, Raybestos-Manhattan, Inc, Passaic, N. J. Catalog discusses friction materials manufactured by company, including woven, folded and compressed, molded, semimetallic and full metallic. Copies sent only to designers and manufacturers of industrial brakes and clutches.

(*Continued on page* 186)

HOW TO ORDER

Be sure to fill out, completely one coupon for each piece of literature you order. (See sample below.) This gives your request authority and helps the manufacturer to address your copy completely. Readers who fail to prepare request blanks correctly may be disappointed under difficult postal conditions and limited quantities of bulletins available today.

Use as many coupons as you need, but cut them out and send them as one block in an envelope addressed to POWER, 330 W. 42nd St., New York 18, N. Y. Only requests made on these coupons will be honored.

FILL OUT AND SEND TODAY! NOT GOOD AFTER OCTOBER 1, 1945

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Your Company Name Brown Mfg Co

Address 3718 First Avenue

Pottsville Oklahoma

Your Name John Smith

Your Title Power Engineer

POWER, 330 West 42nd St., New York 18, N. Y.

Where an inhibition frees tubes of trouble

Condenser tubes in a Liberty ship were failing after only 2 months of service. Inlet and outlet water temperatures were 83°F. and 103°F., with inlet steam temperature at 126°F. The outside surfaces showed a uniform oxide film. Inside, the cooling water had laid down a brown coating of iron oxides. Preliminary examination revealed nothing as to the cause, and samples were turned over to a Scovill engineer for thorough examination.

Laboratory inspection revealed green and white corrosion products in deep pits at several areas of the inside surface. In the bottoms of the pits redeposited porous copper was found.

REDEPOSITED COPPER GIVES CLUE

Scovill identified the trouble as "plug type dezincification," an electro-chemical corrosion which dissolves the metal and redeposits brittle copper. The condenser had been tubed with Aluminum Brass without an inhibiting agent. As recommended by Scovill, at the next retubing this condenser was fitted with Aluminum Brass tubes containing 0.04% to 0.05% of an inhibiting agent and normal tube life was obtained.

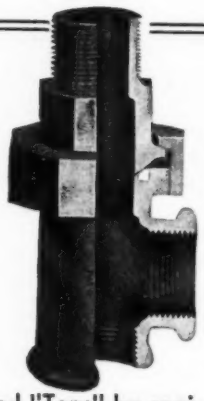
THREE SCOVILL SERVICES

Scovill *Service in Men* provides specialized advice and study on individual tube problems, as in the example above, and on installation practice. Scovill also provides two other services. *Service in Metals* includes the selection of alloys and the study, in the laboratory and in the field, of specific problems for individual customers. *Service in Manuals* offers valuable literature on condenser and heat exchanger tubes. To get your copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 13 Mill Street, Waterbury 91, Conn.

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

CONDENSER TUBES
ONE PRODUCT . . . THREE SERVICES
Service in Manuals . . . Service in Metals . . . Service in Men

JEFFERSON
Specialty UNIONS
with the RECESSED BRASS SEAT



A Big Improvement . . . time-tested and proved "Tops"

These Union Tees which have the union on the run will be found exceedingly useful where piping involves a union near a tee. They are rated "Tops" by engineers because they simplify installation, save pipe joints and assure permanent leakproofness. Made with pipe ends threaded either All-Female or Male and Female.

The Recessed Brass Joint in Jefferson Specialty Unions provides a brass to iron joint which avoids corrosion. It is forced into a machined recess and processed to insure a thorough, permanent tight contact between the ring and the spherical surface of the surrounding iron.

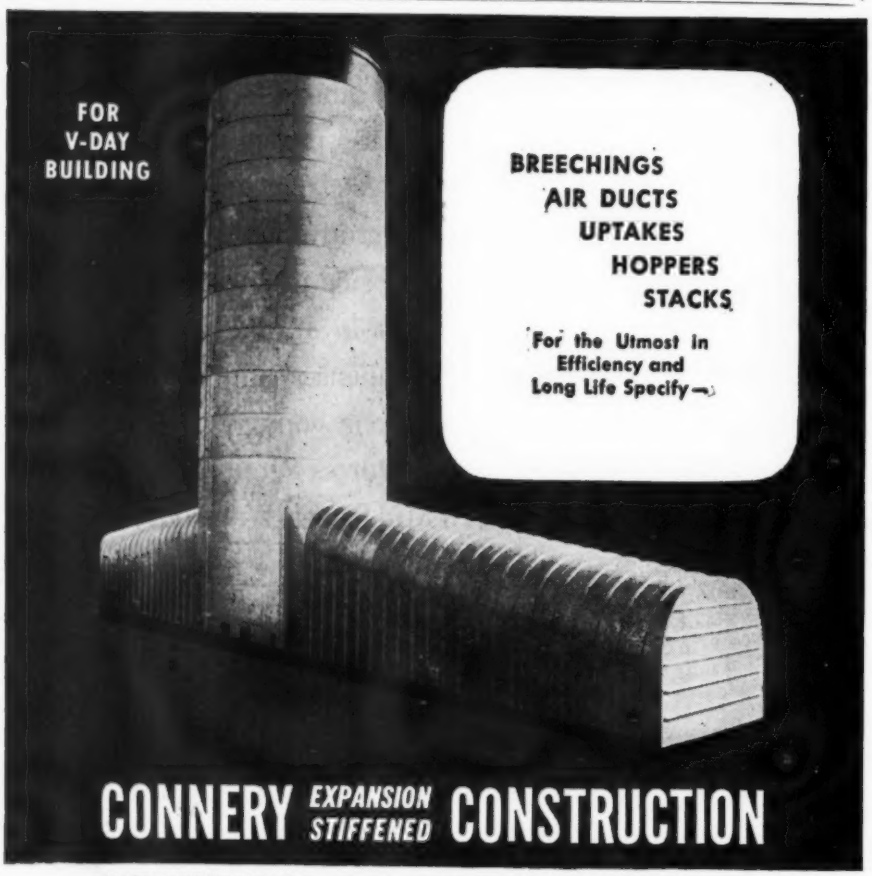
For complete details, contact us or you nearest distributor.

JEFFERSON UNION CO.

601 West 26th Street, New York 1, N. Y.

Factories at

LEXINGTON 73, MASS. **LOCKPORT, N. Y.**



CONNERY *EXPANSION STIFFENED* CONSTRUCTION

CONNERY CONSTRUCTION CO.

SECOND & LUZERNE STS. **PHILADELPHIA**

New Bulletins

(*Continued from page 184*)

21 SELF-LUBRICATING BEARINGS—Morganite Brush Co, Inc, Long Island City 1, N. Y. 6-page folder contains information on metallic and nonmetallic content bearings, composite bearings and machined or molded shapes of special quality, self-lubricating materials.

PIPING, FITTINGS VALVES AND SPECIALTIES

22 SOLENOID VALVES — Automatic Switch Co, 41 E 11th St, New York 3, N. Y. 12-page circular No. 200 describes solenoid-operated valves for automatic and remote control of liquids and gases.

23 PIPE OUTLETS—Dept 257, Bonney Forge & Tool Works, Allentown, Pa. 32-page handbook explains four steps in installing full pipe strength outlets by the WeldOlet method.

24 HOSE AND FITTING—Seamlex Co, 27-27 Jackson Ave, Long Island City, N. Y. Bulletin No. 600 gives data on new Seamlex tubing with Type W fitting for high temperatures and vibrations.

25 WATER HOSE—B F Goodrich Co, Akron, Ohio. Catalog section No. 480 contains sizes, number of plies, weight per hundred ft, outside diameters and working pressures of water hose.

26 UNDERGROUND PIPE CONDUIT—H W Porter & Co, 825 Frelinghuysen Ave, Newark 5, N. J. 4-page bulletin No. 451, entitled "Thermo-O-Tile, The Conduit for Underground Pipe Lines," covers four main advantages of this conduit system and shows a modified design for exceptionally wet or submerged locations.

27 STEAM AND FLUID TRAPS—Clark Mfg Co, 1830 E 38th St, Cleveland 14, Ohio. 68-page catalog describes Clark line of inverted-bucket open-bucket thermal type and float-type steam and fluid traps, pressure-regulating and reducing valves, strainers, separators, globe valves, orifice blocks, etc.

28 PIPE WELDING—Cornell & Underhill, Inc, 149 Broadway, New York 6, N. Y. 4-page folder explains the importance of proper pipe welding.

OTHER EQUIPMENT

29 HOT-AIR HEATER—Harvey-Whipple, Inc, Springfield 1, Mass. 4-page bulletin No. 4501-AH and single sheet Spec A-150, A-300-45 discusses Master Kraft portable hot-air heaters.

30 UNIT HEATERS—D J Murray Mfg Co, Wausau, Wis. 12-page booklet describes corrosion and its influence on unit heaters and their efficient operation.

31 WATER HEATERS—American District Steam Co, North Tonawanda, N. Y. 12-page bulletin No. 35-76B gives capacities, dimensions and lists prices of 22 sizes of water heaters.

32 MAGNETIC EQUIPMENT — Stearns Magnetic Mfg Co, 665 S 28th St, Milwaukee 4, Wis. 4-page folder covers application of magnetic pulleys, suspended magnets and spout magnets for removing tramp iron and metallic junk automatically and economically from flow.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead giving writer's name and title.

★ **ACTUATOR CONTROLS** — Dept 8[illegible] Lear, Inc, Piqua, Ohio. 226-page catalog contains informative data on linear actuators, rotary actuators, power units, screw jacks, flexible power shafting and accessories, motors and controls.

Seal High Pressure Lines This Modern Way . . . and they STAY SEALED!

NO LEAKAGE . . . for 33 years, Flexitallic spiral-wound Gaskets have proved their ability to handle joint sealing problems that other gasket types have left only partially solved. There is no high-pressure gasket problem that Flexitallic cannot solve better and cheaper in the long run!

NO BOLT STRESS PROBLEMS . . . the unique Flexitallic construction makes the joint semiflexible, thus compensating for shocks and sudden line stresses. Centering and gasket yield are balanced with joint bolting and service requirements are minimized.

NO VIBRATION WORRIES . . . flexitallic Gaskets automatically adjust themselves to meet changing or adverse conditions such as vibration, expansion, contraction, etc. On the most exacting wartime jobs, Flexitallic has successfully met one emergency after another — after other gasket types failed.

CHEMICAL PROBLEMS . . . gaskets of special non-contaminating materials represent only one of the many Flexitallic types regularly produced. Whatever your gasket requirement, Flexitallic can match it!

NO MAINTENANCE . . . besides reducing gasket maintenance to a minimum on high-pressure or high temperature applications, Flexitallic holds widespread possibilities for low-pressure use. A slightly higher first cost can mean a lifetime of trouble-free service!

Made in a complete line for extreme temperature and/or pressure ranges for pipe flanges and pressure vessels including boiler manholes, handholes, waterwalls, superheaters, economizers, Diesel and gas engines, pumps, etc. Write for catalog.

"Flexitallic"

REG. U. S. PAT. OFFICE

FLEXITALLIC GASKET COMPANY

8th & BAILEY STREETS • CAMDEN, NEW JERSEY

SAFE, SURE SEALING FOR HIGH-PRESSURE APPLICATIONS

THIS BEARING BRONZE has real advantages . . .

1 CRYSTAL CONTROL — *Magnolia Isotropic Bronze* is cast by an exclusive method which controls the growth of the crystals. The result is a bearing stock that will stand much greater strain than a bronze whose crystal growth is haphazard and undirected.

2 DIE CASTING — When bearing stock is die cast there is no danger of bars being shot full of tiny diamond-hard points of sand that ruin valuable cutting tools and wear shafts like sandpaper.

3 FULLY MACHINED — Bars that are fully machined save from 25% to 50% of the weight usually purchased in rough-cast-foundry-bars, and an equal percentage of machining time. Finished inside, outside, and on the ends, Magnolia Isotropic Bronze requires only a finish cut to bring to size.

Write for folder which explains these advantages in detail.

•

MAGNOLIA METAL CO.
18 West Jersey Street
Elizabeth 4, New Jersey

MAGNOLIA ISOTROPIC DIE-CAST BRONZE
by the makers of
MAGNOLIA ANTI-FRICTION METAL

MAGNOLIA METAL CO. OF CANADA, Ltd.
2028 Manufacturers Street
Point Ste. Charles, Montreal

MAGNOLIA BEARING METALS

33 CONTROL INSTRUMENTS—Hays Corp, Michigan City, Ind. Bulletin No. 45-713 discusses pressure reducing pressure relief or back pressure, flow rate, turbine-driven compressor control, and control of speed, liquid level and liquid density.

34 NONMAGNETIC STEEL—American Manganese Steel Div, American Brake Shoe Co, Chicago Heights, Ill. 32-page bulletin No. 1144-NM points out nonmagnetic applications for Amsco manganese steel.

35 BRONZE ALLOYS — Ampco Metal, Inc, Milwaukee 4, Wis. 12-page bulletin No. 59 describes Ampcoloy alloys, a series of bronzes of controlled analysis. Bulletin contains photomicrographs, tables of physical properties and chemical compositions.

36 INSULATION TESTER — James G Biddle Co, 1211 Arch St, Philadelphia 7, Pa. 8-page bulletin No. 1785 presents midget Megger insulation tester.

37 STEAM TURBINES—De Laval Steam Turbine Co, Trenton 2, N. J. 24-page catalog No. 1181 explains complete line of steam turbines, helical gears, centrifugal pumps, centrifugal compressors, worm-gear speed reducers and IMO oil pumps.

38 ENGINE CONTROLS—Synchro-Start Products, 221 E Cullerton St, Chicago 16, Ill. 16-page booklet presents an informative article, entitled "Automatic Engine Controls," by C A Genske.

39 TURBINE PUMPS—Fairbanks, Morse & Co, Chicago 5, Ill. 6-page bulletin No. AQB400.1 deals with the Fairbanks-Morse Fig. 6920 oil-lubricated turbine pumps with inclosed impellers.

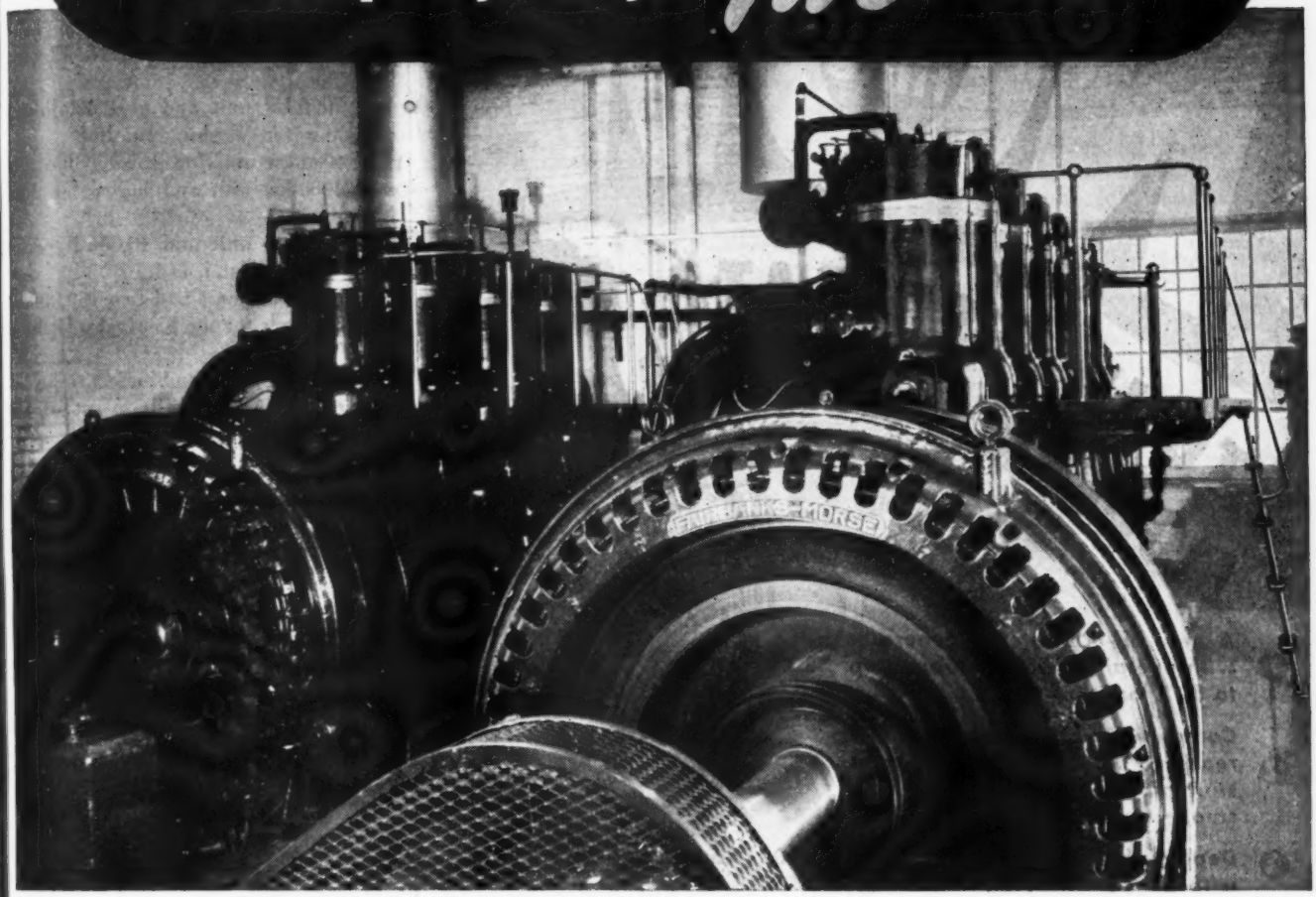
40 PROPELLER PUMPS—Fairbanks, Morse & Co, Chicago 5, Ill. 6-page bulletin No. AQB500.1 discusses Fairbanks-Morse Fig. 6310 Niagara propeller pumps.

41 WATER TREATMENT—Bird-Archer Co, Ltd, 200 McGill Bldg, Montreal, Canada. 40-page booklet presents scientific approach to problems of water treatment and tells about special company facilities.

War Production Board Chairman J A Krug urged users of bituminous coal to stock as much as possible this summer and warned that the cost of storing coal should be looked upon as low-cost insurance for an adequate supply for a given industry. The coal-production deficit will be greater than in any previous coal year of the war. This deficit, according to the Solid Fuels Administration for War, will be at least 25,000,000 tons or more. Production is now being jeopardized by consumers' failure to take certain lower-grade coals. As matters exist now, no industrial consumer next year can be assured of a full supply of coal from current production.

Four government engineers from India are planning to visit the U. S. to study methods and procedures of the Rural Electrification Adm as a possible guide for similar projects in their country. Arrangements for the visit are being made through Dept of Agriculture and State Dept. The Indian engineers who are to receive REA training in St. Louis are R Ramakrishna, Mysore State electricity dept; B R Somayajulu, superintending engineer, Papanasan system, Government of Madras electricity dept; P Venktaramayya, office of the electrical commissioner with the Government of India, Calcutta; and O P Bhasin, assistant commercial engineer, hydroelectric div, irrigation dept, Government of United Provinces.

Diesel Demonstrates $3,700 Saving – Company Buys *Two* More!



JUST one year of Diesel operation saved the makers of Valdura heavy-duty maintenance paints $3,700 in plant power costs. So, as expansion plans went into effect, two more Fairbanks-Morse Diesels went into operation.

This is a typical experience. Such performance is built into Fairbanks-Morse Diesels. They're designed for heavy duty, economical operation, low maintenance costs, and long life. And Fairbanks-Morse Generators are built the same way. Fairbanks-Morse power generating units are engineered before you get them. One maker is responsible, one guarantee covers them. For information on how you can save on power, write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

BUY MORE WAR BONDS

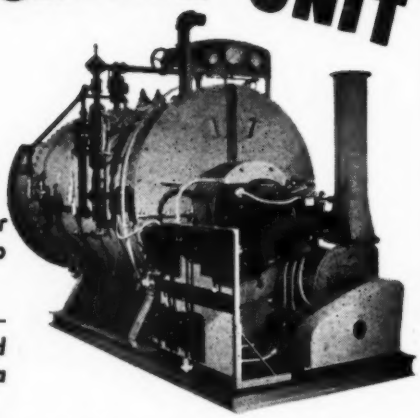
Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps
Scales • Magnetos • Stokers • Railroad Motor Cars and Standpipes

NOW is the time

TO INVESTIGATE THIS MODERN PACKAGE UNIT



1. *A new oil-fired steam generator with overall efficiency stepped up to 80% or more . . .*
2. *Complete in one compact unit—ready to set down, hook up and start producing power, without a smoke stack . . .*
3. *Dependable—perfectly coordinated—100% automatic operation . . . with Bunker oils . . .*
4. *Includes oil burner, induced draft fan, boiler, piping, wiring, controls—every part necessary for operation . . .*
5. *Saves boiler room space . . . 20 to 500 HP sizes*

PREFERRED

UNIT STEAM GENERATOR

This outstanding new type power plant, perfected to meet wartime needs, has been thoroughly proved under varied high production demands. Send coupon for illustrated bulletin giving full information.

— — — — — — — — — — **MAIL THIS NOW** — — — — — — — — — —

Preferred Utilities Mfg. Corp.
1860 Broadway, New York 23, N. Y.

Please send me Bulletin 1000, describing Preferred Unit Steam Generators. Also the booklet DIVIDENDS FROM YOUR POWER PLANT, with special vital information for plant executives.

NAME .....

ADDRESS .....

P-7-45

PREFERRED UTILITIES

Power News

(*Continued from page* 130)

hour boiler for Glendale, California.

A 20,000-kw unit for Caddo Lake plant of Southwestern Gas & Electric Co.

A 5000-kw unit and a 10,000-lb-per-hr boiler for Washington, Ind.

A 4000-kw unit for Dover, Ohio.

A 4000-kw unit and boiler for Norwalk, Ohio.

A 5000-kw unit and 10,000-lb-per-hr boiler for Portland, Ind.

A 25,000-kw unit and two 150,000-lb-per-hr boilers for the Kentucky Utilities Co, Tyrone, Ky.

A 75,000-kw unit and boiler, to be No. 8 machine at Marysville plant of Detroit Edison Co.

A 15,000-hp diesel with auxiliaries, substation and transmission line for Butler plant, near Allison, Iowa, of Federated Cooperative Power Assn and an 11,020-hp diesel with auxiliaries, substation and transmission line for its Grundy plant near Dinsdale, Iowa.

A 3060-hp diesel for Hutchinson, Minn.

A 5000-kw unit and auxiliaries for Millville Mfg Co., Millville, N. J.

A 10,000-kw unit for White Oak cotton mills plant of Proximity Mfg Co, Greensboro, N. C.

A 3500-kw unit for Groveton Paper Co, Groveton, N. H.

Two 35,000-kw units and a 450,000-lb-per-hr boiler for New Castle plant of Pennsylvania Power Co.

New coal loading and handling equipment at Acme Station of Toledo Edison Co.

A 100,000-kw unit and a 900,000-lb-per-hr boiler for Essex Station of Public Service Co of N. J., replacing obsolete equipment installed in 1915.

A 40,000-kw unit and a 430,000-lb-per-hr boiler for Mystic plant of Boston Edison Co.

A 25,000-kva unit for Alder Station of Tacoma, Wash., and the remainder of the necessary parts for its second unit.

A 60,000-kw unit and two 350,000-lb-per-hr boilers, plus some transmission lines for Burger Station of Ohio River Power Co, subsidiary of Ohio Public Service.

A 40,000-kw unit and a 450,000-lb-per-hr boiler for Manchester Street Station of Narragansett Electric Co.

Postwar fluorescents will be long and slender—42 and 64 in. long, with $\frac{3}{4}$ in. dia. Later, lamps 72 and 96 in. long may be manufactured.

How BERNITZ BLOCKS are helping check labor turnover in hundreds of boiler plants

DUE to wartime restrictions on the flow of coal from one field to another, many boiler plants have to burn coal for which their equipment was not designed. Lower quality fuels also have to be burned at higher rates to maintain capacities. Clinker adhesion and ash removal problems are intensified, and the extra labor burden falls on the boiler room crews.

Moreover, military demands on manpower have made the boiler room jobs tougher for those who are left to carry on. Sometimes the added load is too much to bear. The natural thing to do when a job gets too tough is to look for an easier one.

BERNITZ SUPER BLOCKS are helping to check labor turnover in many hundreds of boiler plants today. By keeping the walls free of clinker they minimize the work required for cleaning and dumping fires; maintain 100% active grate surface at all times. In short, they improve working conditions.

As the chief engineer of a large paper mill in Michigan recently put it: "If we had to go back to the days before we installed Bernitz Blocks, using the coal we have to burn today, my gang would walk out of here."

BERNITZ SUPER BLOCKS reduce maintenance to settings and reduce furnace outage, contributing further to overall economy in the expenditure of man-hours of labor.

BERNITZ SUPER BLOCKS are made of "Carbofrax",* the silicon carbide refractory which inherently resists clinker adhesion. By taking advantage of the high thermal conductivity of "Carbofrax"* with shapes correctly designed for large air contact area, BERNITZ SUPER BLOCKS can be easily cooled below the fusion temperature of the ash. Write for free descriptive Bulletin B-344.

*"Carbofrax" is the registered trade mark of, and indicates manufacture by, the Carborundum Company.

BERNITZ FURNACE APPLIANCE CO.

89 BROAD STREET, BOSTON 10, MASS.

New York Philadelphia Detroit Buffalo Syracuse Atlanta Pittsburgh Cincinnati Chicago Indianapolis Minneapolis St. Louis Cleveland
In Canada: Williams & Wilson, Ltd., Montreal and Toronto

BELOW: After 18 months' heavy usage (300 to 350% ratings) and only occasional Sunday shutdowns, these Bernitz "Carbofrax" Blocks are in almost new condition.

AT RIGHT: Rear view of Bernitz all "T" construction blocks.

BERNITZ SUPER BLOCKS

OTHER PRODUCTS INCLUDE: BERNITZ FURNACE LININGS • BERNITZ NYGAARD WATER WALL • BLOCKS FOR WALLS AND ARCHES • BERNITZ AIR-COOLED FLOORS BERNITZ SUPERGENERATOR LININGS FOR WATER GAS SETS

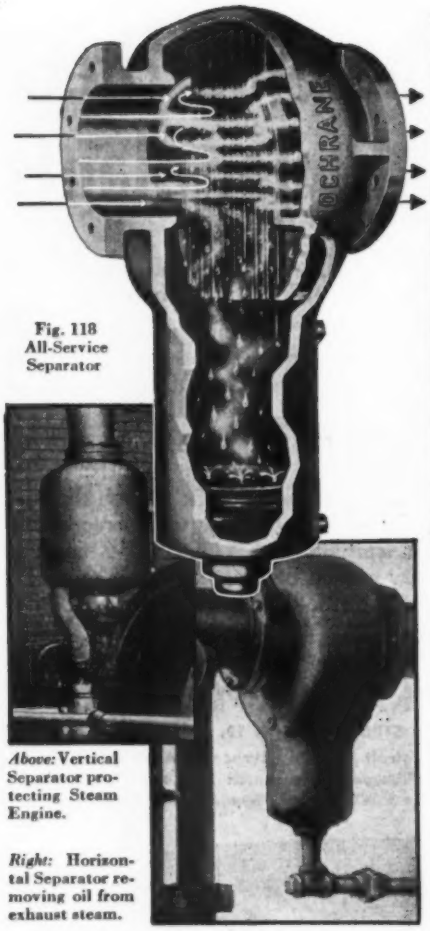


Fig. 118
All-Service
Separator

Above: Vertical Separator protecting Steam Engine.

Right: Horizontal Separator removing oil from exhaust steam.

Avoid the High Cost of

DIRTY, WET, OILY STEAM

Keep It Clean and Dry with

COCHRANE

ALL-SERVICE

SEPARATORS

You can completely remove moisture and solid entrainment from dirty, oily, wet steam, air and gases by installing Cochrane Separators. Complete purification is assured, due to exclusive design of baffles and ports which produce a direct, unrestricted fall of entrainment, prevent the purified steam from passing over the drip area, and minimize pressure loss by means of extra large port areas.
Write for details.

COCHRANE CORPORATION
A DIVISION OF AMERICAN ENGINEERING COMPANY
3106 N. 17th St., Philadelphia 32, Pa.

Reconversion Notes On Power Equipment

War Production Board "open-ended" the Controlled Materials Plan, effective July 1, to permit the delivery thereafter, without CMP allotment numbers or symbols, of steel, copper and aluminum that can be delivered without interference with CMP rated orders. Orders for this unrestricted delivery after July 1 may be placed immediately. It was anticipated that further liberalization of order U-1 would be made effective after the "open-ending" of CMP takes effect. Also, WPB has removed most "rating floors" to permit placing of unrated orders where production and delivery will not interfere with rated order flow.

WPB has issued Amendment 2 to Priorities Regulation 13, removing restrictions on special sales of excess or surplus steel, copper and copper-base alloy and aluminum in controlled materials forms. These may now be sold to anyone without WPB authorization and without requiring buyer to use a CMP allotment number or symbol.

WPB has revoked four orders governing production of electrical equipment and removed "rating floors" established by the orders. The revoked orders are: (1) L-250, covering electric-motor controllers (2) L-221, covering electric motors and generators (3) L-273, covering busways (4) L-315, covering inclosed safety switches, inclosed branch and service circuit breakers, service entrance equipment, panel and distribution boards and knife switches.

Removal of 85% magnesia pipe covering from Army and Navy Munitions Board's revised List of Prohibited Items for Construction Work takes away the final barrier to full use of the product by industry. The former WPB restriction had been deleted in Nov, 1943.

Office of War Utilities is expected to accede to a recommendation by the Land Steam Turbine and Turbine-Generator Industry Advisory Committee that scheduling of production of this equipment be ended by July 1. Manufacturers reported that factory space is becoming available for this equipment and that anticipated new orders can be filled without the scheduling mechanisms of order M-293.

Manufacturers of switchgear and power-switching-distribution equipment recommended to OWU that scheduling of switchgear production continue at least through the third quarter. Industry representatives suggested that Schedule IV of order L-154 be amended to revoke all provisions except those that would increase the manpower required for the design and manufacture of metalclad switchgear.

Cancellation of discounts on turbine generators and switchgear by General Electric, Westinghouse and Allis-Chalmers, finally effective June 1 and May 16 respectively, brought a flood of approvals for utility construction projects from the OWU power div. The approvals were confined almost

XZIT

FIRE-SCALE AND SOOT ERADICATOR

Eliminates Soot and Fire-scale without chipping or scraping

Manual chipping of fire-scale and scraping soot from boiler heating surfaces wastes valuable time and labor, and ties up the unit.

Simply feed Xzit into the fire-box while your boilers continue to operate, and all accumulated fire-scale and soot will be reduced chemically so they can be dissipated by natural draft or blowing, without chipping or scraping.

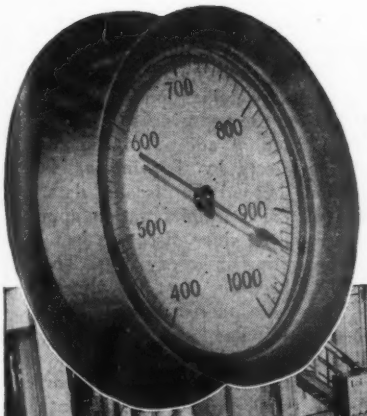
Xzit stops sparking and extinguishes stack fires instantly. Periodic use keeps heating surfaces clean, saving fuel and reducing maintenance.

Xzit is being used in all types of stationary power plants and on board American and Allied merchant and naval vessels.

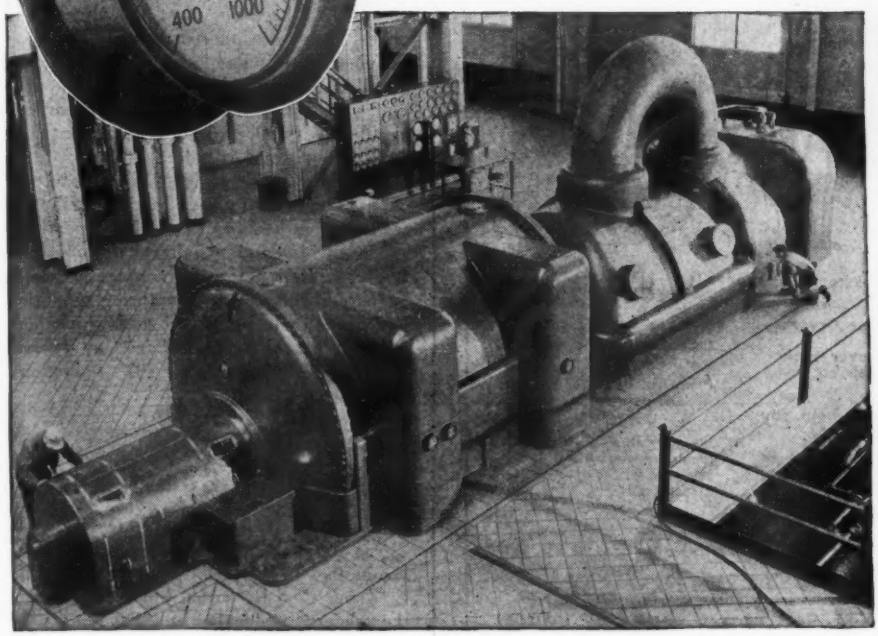
Write for demonstration in your plant.

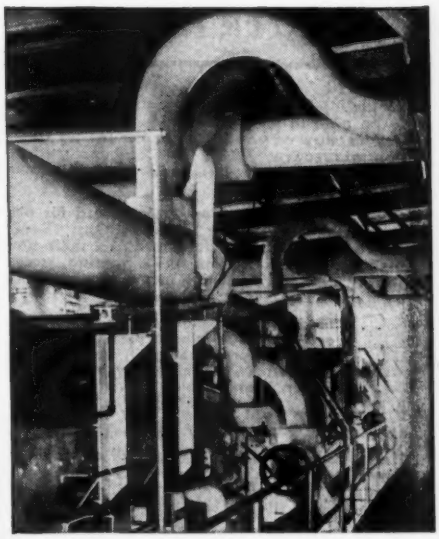
XZIT FIRE-SCALE and SOOT ERADICATOR

Plants at
1031 Clinton St., Hoboken, N. J.
5800 S. Hoover St., LOS ANGELES 44, CALIF.



Steam pressures and temperatures are on the UP and UP





HIGH PRESSURE feed water heaters, main steam pipe, heater drains and main feed pipe fabricated from NATIONAL Seamless Pipe.

A vital reason for using

NATIONAL SEAMLESS

WHAT engineers termed high pressures and temperatures ten years ago are low compared with today's practice. And the 2500-pounds pressure and 1000-degrees temperature found in some of today's plants may be considered low by future engineers. It is very much of a relative question, but highly important in its application to boiler tubes and power piping.

Development and manufacture of NATIONAL Seamless Steel Pipe and Tubing to match the progress in boiler plant design, has been in line with NATIONAL Tube Company policy. Our metallurgists and craftsmen have consistently met the increases in steam pressures and temperatures by being able to supply the kind of pipe and tubes wanted. They are fully prepared to cooperate in meeting the future engineering requirements for seamless steel tubular products.

No finer piping has ever been made for power plants than NATIONAL Seamless. In many cases involving severe or hazardous service, the use of seamless pipe is mandatory. "Walls Without Welds" means absolutely seamless—no longitudinal line of potential weakness.

Uniform wall strength has a direct relation to bending, expanding, beading or other working of the pipe—a vital requirement when modern power plants are being built! Use NATIONAL Seamless Pipe for your high temperature, high pressure lines—and NATIONAL boiler tubes, superheater tubes and condenser tubes for your boiler-room equipment—made to Standard A.S.T.M. specifications for high temperature and high pressure service.

WALLS WITHOUT WELDS

NATIONAL TUBE COMPANY

Pittsburgh, Pa.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
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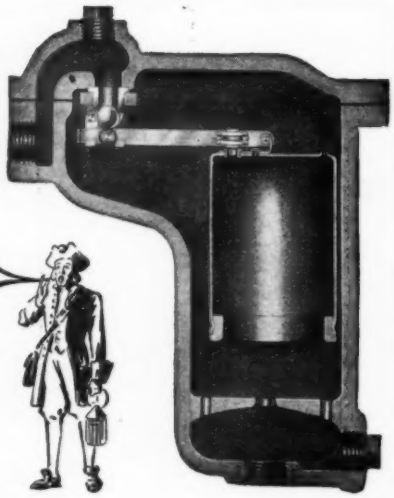
NATIONAL TUBE COMPANY USS STEEL UNITED STATES STEEL

UNITED STATES STEEL

CRYER TRAPS

help solve the man-power problem!

"All's Well with CRYER TRAPS"



To install Cryer Traps on your steam lines is to be able to forget them. Experience proves Cryers stay on the job with almost no attention whatsoever . . . a fact that can mean a lot today to plants with reduced maintenance crews.

Cryer Traps have an enviable record for performance worth your consideration. Every claim we have made for them . . . their non-binding, positive action, quick venting, accessibility and easy maintenance . . . have been demonstrated by such actual user experience as this:

- . . . no tax put on limited man-power, because Cryers are 100% satisfactory.
- . . . attention practically nil, because they never stick and require cleaning only at long intervals.
- . . . Cryer Traps really operate.

If you really want to know how Cryer Traps will help you solve your man-power problem, just ask Cryer users.

The features of Cryer Traps which make boosters out of Cryer users are fully described in literature available promptly on request.

SPECIFICATIONS

Sizes: ⅛" to 2½"

Capacities: 500 to 38,000 lbs of water

Pressures: Up to 250 lbs.

●

We carry all sizes of traps and repair parts for the line formerly known as the J-M Ball Steam Trap

CRYER TRAP AND VALVE CO., INC.

366 MADISON AVE. NEW YORK, N. Y.

Manufacturers of steam specialties for more than 40 years.

EDCO ROTARY PUMPS

VANE TYPE
PATENTED CONSTRUCTION

At high or low speeds . . . whether creating a 28" vacuum or developing extremely high pressures . . . the vanes of EDCO Pumps maintain effective spanning position without springs or centrifugal action.

Fuel transfer pumps, coolant pumps and motor-driven assemblies. Furnished in capacities from 2 GPH up, in any required corrosion-resisting material. Operates silently at all speeds. Minimum maintenance required. Used for fuel oils and other fluids of any specific gravity.

FOR COMPLETE DATA . . . write today. Ask for Bulletin 936.

EDDINGTON METAL SPECIALTY CO.

P. O. Box K **Eddington, Pa.**

exclusively to projects that would have been approved in a matter of time anyway and only a limited number of approvals represented any relaxation of standards. OWU hurried the approvals so as not to be in the position of adding to the cost of essential projects by delaying action on applications beyond the discount date.

Office of Price Administration approval was not required since discounts had been offered on ceiling or lower prices. The discounts had been in effect for almost one year. They were offered because the large volume of turbine and switchgear work had afforded substantial savings in unit costs and were withdrawn because of the drastic slump in turbine orders. Discounts on many electric motors manufactured by these companies were canceled May 14 and discounts on some power and distribution transformers had been canceled recently.

The turbine and switchgear discounts actually expired before May 16 and June 1, but orders on which firm price quotation had been made by May 1 and which bore OWU approval dated before May 16 and June 1 were held eligible for the reductions.

Yellott Directs Locomotive Committee

Dr John I Yellott has been selected to direct the new $1,100,000 program of the locomotive development committee of Bituminous Coal Research, Inc, for increasing the efficiency of locomotives through the use of powdered coal, development of turbine drive and application of modern steam-power principles, it has been announced by the chairman of the committee, Roy B White, president, Baltimore & Ohio R R. Mr Yellott, who will make his headquarters in Baltimore, is now director of the Institute of Gas Technology of the Illinois Institute of Technology and is the inventor of a new method of pulverizing coal through the direct action of steam.

This newly organized research program is sponsored by six railroads and three coal companies, including the B & O, Chesapeake & Ohio, Louisville & Nashville, New York Central, Norfolk & Western and Pennsylvania R R; M A Hanna Co, Island Creek Coal Co and Sinclair Coal Co.

Weigel Reelected ABMA President

A C Weigel, vice-president of Combustion Engrg Co, was reelected president of the American Boiler Manufacturers Assn and Affiliated Industries at the association's 57th annual meeting, June 3 to 6. Other reelected officers are Vice-president Frank G Brinig, president of Erie City Iron Works, and Secretary A C Baker.

The Associate Members group, manufacturers of boiler materials, parts and accessories, elected the following ticket: Chairman, W P Thomas, president of Diamond Power Specialty Co; vice-chairman, J Rowland Brown, president of Reliance Gauge Column Co; secretary-treasurer, A C Baker. Mr Thomas succeeded Philip W Swain, who had completed his second term as chairman of the Associate Members.

A.P.I.—A.S.M.E. and A.S.M.E. CODES • CARBON STEEL AND SPECIAL STEEL

WELDED PRODUCTS by Vogt

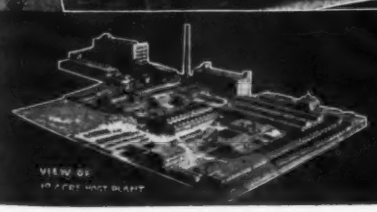
1 - 4'—0" dia. x 7'—6" dia. x 82'—5" high Stabilizer Tower for a Texas Refinery. Fabricated to A.P.I.-A.S.M.E. Code, stress relieved and X-rayed. 250# working pressure.

2 - Heat Exchangers, for an Eastern Refinery, on the testing floor. Units have fusion welded Monel Metal shells and were built to customer's specifications.

3 - 48" dia. x 22'—6" long mud drum for a Vogt Water Tube Boiler designed to operate at 450# S.W.P. Fusion welded to A.S.M.E. Boiler Code.

4 - Battery of Absorption Columns in a Western Refinery. Units are 33" dia. x 41'—0" high and were stress relieved after welding.

5 - 400 KV Industrial X-ray unit in our plate welding department. Exographs of welded seams can be quickly made because of the special motor operated rolls and traveling carriages which are adjustable to vessels of any size.



HENRY VOGT MACHINE CO.
Incorporated
LOUISVILLE, KENTUCKY
BRANCH OFFICES: NEW YORK · PHILADELPHIA · CLEVELAND · CHICAGO · DALLAS

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for water, steam, oil and gasoline service

Next time you give stuffing boxes the regular, frequent check they need under today's operating conditions, have near at hand Belmont's PACKING RECOMMENDATION CHARTS.

They will enable you to select from the complete Belmont line the packing that is right for the job. There is hardly a conceivable service for which Belmont cannot provide the packing that will keep equipment operating at maximum capacity — without leaks that waste power, cut down production and cause expensive replacements.

Belmont Distributors are located in every large industrial center, ready to serve you promptly from local stocks. Get the PACKING RECOMMENDATION CHARTS from the one nearest you — or send the coupon to us.

Have us send you the handy PACKING RECOMMENDATION CHARTS, plus information on the complete line of Belmont Packings

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THE BELMONT PACKING AND RUBBER COMPANY
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Gentlemen: Please send PACKING RECOMMENDATION CHARTS for the services checked:

☐ Steam . . . ☐ Hot Water . . . ☐ Cold Water . . . ☐ Brine . . . ☐ Ammonia . . .
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APPOINTMENTS

Briggs Clarifier Co announces appointment of **Charles W Miller, Jr** as member of engineering staff. **A M Andrews** joins staff as one of chief service engineers for aviation div; **George S Garrard** is appointed chief engineer . . . **Boyd V Giese** heads flash welder div of **Progressive Welder Co. A J Aulerich** and **Wm F Grimes** form partnership of **Aulerich and Grimes** to represent **Progressive Welder Co** in western Ohio industrial area. **Duer Engineering Co** is formed by **Walter Pestrak** and **Paul L Duer** to represent company in eastern Ohio and western Pa. . . . **Monsanto Chemical Co** advances **Norris Boehmer** and **Clarence Barbre** to manufacturing superintendents. **E W Lieben, W Neil** and **R L Miller** are made operating superintendents. **Henry V Moss** is transferred from research laboratory at Carondelet, Mo., to Anniston, Ala., as supervisor of inorganic research. **Dr Earl W Gluesenkamp** and **Dr James H Lum** are appointed asst directors of research at company's central research laboratories. **John F Queeny** plant announces promotion of **Robert C Thumser** to plant engineer. **W C Durning** was advanced to superintendent of power plant and **Norville Predock** becomes superintendent of maintenance and construction.

J F Lee is appointed merchandising manager for **Graybar Electric Co** in N. Y. and N. J. **J P Darcy** will assist him . . . **Major David R Webster** resumes duties as sales manager at **Reznor Mfg Co** . . . **Sterling Electric Motors, Inc** announces appointment of **Arval Morris** as national sales manager . . . **Clarence H Schuettenberg** is appointed sales manager of **Link-Belt Co's** stoker div, with headquarters at 2410 W 18th St, Chicago, Ill. . . . **Timken Roller Bearing Co** elects **Albert L Bergstrom** vice-president of engineering. **O J Horger** is appointed chief engineer of railway div with **C L Eastburg** assistant chief engineer. **P C Paterson** becomes service manager.

Continental Foundry & Machine Co announces appointment of **Frederick G Schranz** as vice-president in charge of hydraulic and special machinery sales, with headquarters at 903 Grant Bldg, Pittsburgh . . . **C O Bartlett & Snow Co** transfers **John J Watson** to Detroit sales office . . . **A Milne & Co** is named national distributor for wrought-iron bars manufactured by **A M Byers Co** . . . **Morse Chain Co** appoints **Paul W Bernhard** advertising manager.

General Electric Co appoints **B F Ilsley** manager of wire and cable div, central station divisions, which will be divided into two sections. Sales managers are **J S Overstreet,** cable div, and **J J Curtin,** magnet wire div. **Carl A Salmonsen** is named manager of Philadelphia Works and **Robert Paxton** becomes manager of GE Pittsfield, Mass., Works to succeed **L E Underwood** who retires. **C A B Halvorson,** consulting engineer for lighting div, retires after 47 years with company. **J E N Hume,** commercial vice-president

QUICK QUIZ:

Are you in a fog about the future?

Is it a question of:

Obtaining high employee efficiency even on hot, humid days?

Eliminating air-borne dusts that mar metal surfaces?

Avoiding the errors in "miking" of metals which result from changing air temperature?

Minimizing surface film of moisture on metal parts to avoid corrosion?

Minimizing fingerprint etchings made by perspiring hands?

Maintaining a quiet, dust-free drafting room, without outside noises or winds?

EASY ANSWER:

CARRIER can clear up these problems for you with the most advanced, scientific air conditioning. Carrier Air Conditioning and refrigeration today is the product of 43 years of specialized experience. They represent the newest developments in proven principles and correct techniques. You can depend on a Carrier installation for effective results, highly efficient operation, long life and low maintenance costs. On present or post-war plans for air conditioning, refrigeration and unit heating, consult Carrier first. No obligation. Write today.

Carrier Corporation, Syracuse, N. Y.

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AIR CONDITIONING • REFRIGERATION

INDUSTRIAL HEATING

8 x 19 Macwhyte Special Traction Steel, PREformed or Non-PREformed

6 x 19 Macwhyte Traction Steel, PREformed or Non-PREformed

Safe, dependable, economical Macwhyte Elevator Ropes are made of selected steels best for elevator service. Wire is drawn in Macwhyte's own mill under complete metallurgical control.

The complete line of hoisting, counterweight, compensating and governor ropes made by Macwhyte, gives you the correct ropes for your equipment.

Ask your Elevator Maintenance Man to install Macwhyte Elevator Ropes. He can get them from Macwhyte Distributors or Mill Depots.

Send for this complete listing of Macwhyte Elevator Ropes in handy, vest pocket size. Ask for Elevator Catalog E-9. NO. 822-E

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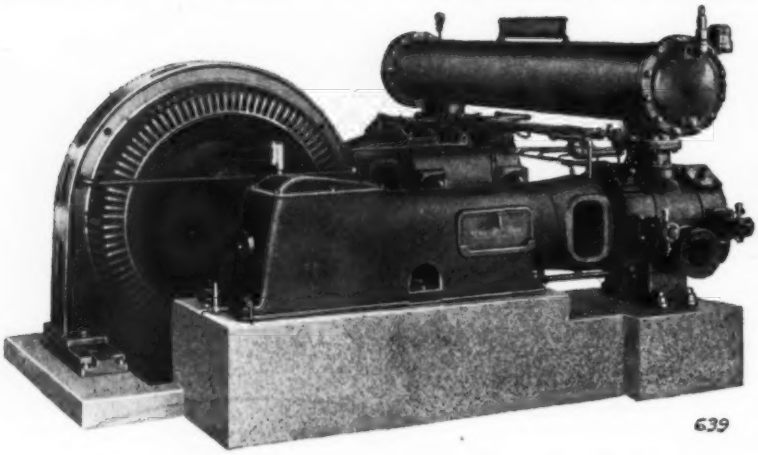
2944 Fourteenth Avenue
Kenosha, Wisconsin

Specify MACWHYTE ELEVATOR ROPES
The CORRECT ropes for your equipment

ENDURING SERVICE



639

For economy of operation and maintenance; for dependable performance in continuous heavy duty service over long periods, PENNSYLVANIA duplex, direct connected, synchronous motor driven compressors of the type illustrated have earned the endorsement of industry wherever installed.

Please send for descriptive Bulletin No. 192.

PPC

PENNSYLVANIA PUMP & COMPRESSOR CO.
BUSHKILL PARK ROAD, EASTON, PENNA

and manager of industrial divisions, and **J W Belanger,** manager of federal and marine divisions, have been named assistant managers of sales of apparatus dept. **Karl H Runkle** and **R S Neblett** will succeed them in their former positions. **W V O'Brien** is appointed manager of central station divisions, succeeding **H V Erben** who became genl mgr of apparatus dept.

Macwhyte Co appoints **Fred M Sime** district sales manager for Pacific Southwest and **Wm J Brett** district sales manager for Pacific Northwest . . . **Wickwire Spencer Steel Co** announces appointment of **Alvin F Franz** as general superintendent of Buffalo plant . . . **Allis-Chalmers** appoints **Charles F Codrington** assistant to manager and **A E Caudle** sales manager of blower and compressor dept. **Grant M Hinkamp** joins company as industrial engineering specialist. **J C Schaefer** is named branch office manager at Youngstown, Ohio. He succeeds **E H Legler** who is transferred to electrical dept at Milwaukee. **L E Stacey** transfers to Wheeling, W. Va., as resident field engr.

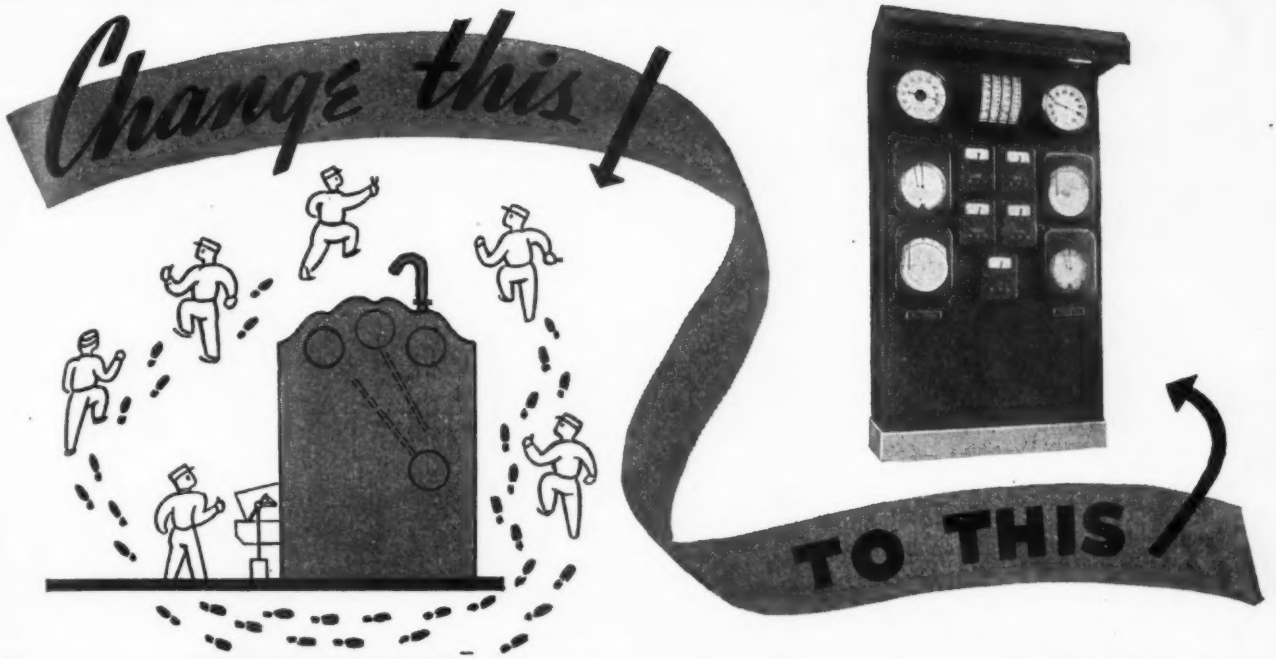
Public Service Corp of N. J. elects **Lyle McDonald** and **Jacob T Barron** directors. They succeed **Edmund W Wakelee** who died recently and **John L O'Toole** who resigned because of illness . . . **Winslow Engineering Co** advances **R S Zirbel** to production manager . . . WPB approves new building and plant facilities of **Marlo Coil Co,** St Louis.

Westinghouse Electric Supply Co appoints **Charles R Lee** manager of New Orleans branch. **G H Lineberry** becomes apparatus and supply manager of Pittsburgh district. **Corpus Christi** branch names **C M Reynolds** manager. **L J Clay** becomes manager of San Antonio, Texas, branch. In North Pacific district, **Albert L Wiegenstein** is appointed apparatus and supplies manager, and **H E Bailey,** with headquarters in Seattle, is made district utilities manager.

Westinghouse Electric Corp announces appointment of **John J Hayes** as Pacific Coast district treasury manager. **Gwilym A Price** is appointed executive vice-president. **Frank W Godsey, Jr,** becomes manager of new products div. He succeeds **G H Woodard,** who is transferred to South Philadelphia as manager of aviation gas turbine div. **C E Stephens,** vice-president, retires after 45 years service. **Gerard H Welch** is appointed assistant to manager of switchgear and control div. Board of directors elects three vice-presidents to head treasury, law and patent departments and lamp manufacturing and lighting equipment divisions. They are **L H Lund, William E Miller** and **Ralph C Stuart. H C Bourns** is appointed central district supervisor at Mansfield, Ohio, of refrigeration specialties department.

Hewitt Rubber Corp announces promotion of **Joseph H Hayden** to vice-president. **William H Watkins** is named comptroller and assistant treasurer . . . **Beaumont Birch Co** elects **Wm G Davenport** president, **Raymond A White,**

ELECTRICAL OPERATION IS AS MODERN AS POST WAR INDUSTRY MUST BE!

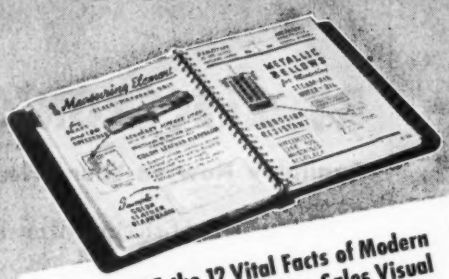


How HAYS Combustion Control saves miles and miles of footwork

LOOK at the steps necessary in manual operation of a steam plant—to adjust boiler dampers, air distribution, fuel feed, fan dampers—not to mention a dozen routine duties of operating, inspecting, maintaining.

Now look at the Hays Combustion Control method—orderly, harmonious, automatic, measures every variable accurately; translates every need for adjustment into operating impulses; transmits these impulses to the power units that make the adjustments: all done instantly—a complete and effective coordination whose advantages are accuracy, sensitivity, speed and power.

You get far more efficient combustion with this simple, well engineered, dependable method—save incalculable man-hours, save fuel, save important money. It's good business to *see* how it can help you by seeing the Hays Visual Presentation. A Hays representative will show it to you—and a line to us makes the contact.

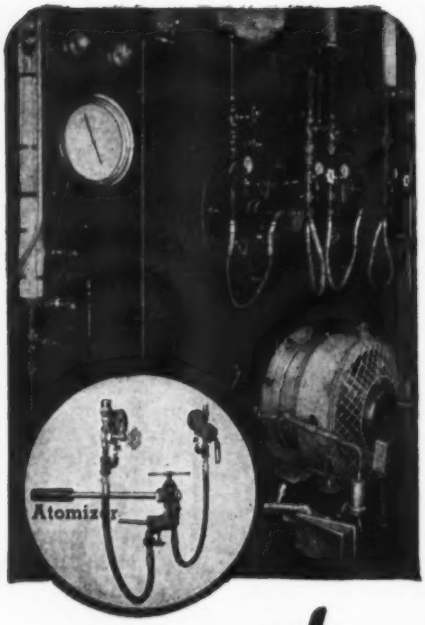


...You SEE the 12 Vital Facts of Modern Combustion Control in Hays Sales Visual

The most comprehensive, most understandable explanation of automatic combustion control ever compiled. Ask the Hays representative to show it to you.

1. The purpose of Combustion Control.
2. How that Purpose is accomplished —3 methods of control.
3. What results can be expected of each.
4. Elements of a *good* control system.
5. Elements of a good controller.
6. *Coordinating* the controllers.
7. Selecting the best system for your needs.
8. How Automatic Combustion Control operates.
9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

The HAYS CORPORATION
SINCE 1901 COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A



Efficient combustion with

Enco Burners

FOR ALL GRADES OF LIQUID FUEL

Enco Burner Units of Steam or Mechanical Atomizing Types are made in various sizes with capacities from 1 to 1000 gallons per hour.

Designed for operation either with or without air registers and for natural or forced draft.

The Enco Interchangeable Atomizer is made for instant change of guns for operation by either steam or mechanical system or to cover a wide range of capacity.

Enco Atomizers are used with various types and makes of pulverized-coal and gas-burner units to provide a dual fuel unit for cold starting, or for full-load operation when coal or gas is not available, or use when oil is the more economical fuel.

We have made many installations during the past 25 years and are ready to cooperate with those looking for better operation and assurance against loss of steam output.

THE ENGINEER CO.
Enco 75 West St. New York 6, N. Y.

Jr, vice-president, **C T Birch** treasurer, **M H Effrig** secretary and **Florence L Birch** assistant secretary . . . **Joshua Hendy Iron Works** appoints **C G Cox** to executive staff . . . **Wheelco Instruments Co** names **Emery J Stevenson** secretary-treasurer . . . **Clifford E Alden** joins **Foxboro Co** with headquarters at home office, Foxboro, Mass. **Harry D Wagner** is added to company's Cleveland staff . . . **Rockbestos Products Corp** elects **H O Anderson** vice-president in charge of sales . . . **W B Connor Engineering Corp** appoints **Harry A Pillen Co**, 626 Broadway, Cincinnati 2, Ohio, and **Allen, Mitchell & Co**, 1053 31st St N W, Washington 7, D. C., to handle *Dorex* adsorption equipment and *Kno-Draft* diffusers.

Elmer L Lindseth

Cleveland Electric Illuminating Co elects **Elmer L Lindseth** president to succeed **Eben G Crawford** who died April 17. He was also elected a director and member of executive committee. **Dean C Ober** becomes vice-president succeeding Mr Lindseth . . . **Los Angeles Dept of Water and Power** promotes **Burton S Grant** to asst chief engineer of water works and **William S Peterson** to asst chief electrical engineer. **Laurance E Goit** is head of municipal water system and **Charles P Garman** becomes executive head of power system.

Clark Mfg Co, 1830 E 38 St, Cleveland Ohio, announces change in nationwide sales and distribution of products. Previously, steam and vacuum traps, pressure regulators, separators and other steam specialties were manufactured by **Clark** for another company. From now on product designing, engineering, manufacturing, sales and distribution will be under **Clark Mfg Co** and sold as Clark fluid controls . . . **Baldwin Locomotive Works** formed Baldwin Locomotive Works of Canada, Ltd, with headquarters in Toronto. Officers elected are: **Ralph Kelly**, president; **W Horace Holcomb**, vice-president; **W N Brownlie**, managing director; **H D Humphreys**, secretary-treasurer and **T E McFalls**, asst secretary-treasurer.

Detrex Corp, Los Angeles branch, establishes new offices at 318 West 9th St, Los Angeles 15, Calif . . . **R-S Products Corp** appoints **Fluid Controls Co** exclusive valve distributors . . . **Morse Chain Co** announces appointment of **Frank M Hawley** as vice-president and general manager

STOP FISH

BY ELECTRONICS

Available Now on Your Priority

This patented fish control method employs modern electronics in overcoming a serious operating and maintenance problem. Fish of all sizes are kept at a *safe distance* from intake structures, or screens, by the use of an Electronic Control Unit. This equipment, generating special electrical impulses, energizes an electrode system designed and engineered for your particular fish control problem.

The Burkey Electric Fish Screen has been thoroughly proven through years of service in Condensing Water Intakes, Hydroelectric Plants, Water Systems and Industrial Pumping Installations. DOES NOT STUN OR KILL FISH.

Recommended by State Conservation Officials.

Free literature and quotations upon request.

Electric Fish Screen Co.

1130 No. Poinsettia Place
Hollywood 46, California

TENSION RIGHT...EFFICIENCY HIGH... MACHINES PRODUCING...ALWAYS

WITH THIS F.L.A.T. DRIVE

You always *know* belt tension is right on a Flat Leather Automatic Tension drive. The pivoted motor base regulates tension automatically — high when the load is heavy, low when the load is light. There is no gradual, undetected slackening of the belt until it wears out from heat due to slippage!

Efficiency remains high above or below rated capacity (and most drives *do* run at less than rated capacity most of the time). A flat leather belt on a pivoted motor base drive operates at close to maximum efficiency from 50 to 150% of rated capacity at rated tension. Other short-center drives lose efficiency rapidly at loads either lighter or heavier than rated.

Production continues, uninterrupted, because the F.L.A.T. drive is never stopped for base adjustment.

Ask your Graton & Knight distributor for a demonstration.

Dependable, trouble-free service on a Flat Leather Automatic Tension drive is provided by "Research" Leather Belting, manufactured by processes which make it ideal for drives operating at higher speeds, over short centers and small pulleys.

Its greater pliability means it can withstand the constant flexing. Its "built-in" pulley grip means less tension required to deliver full power without slip. No idlers are necessary.

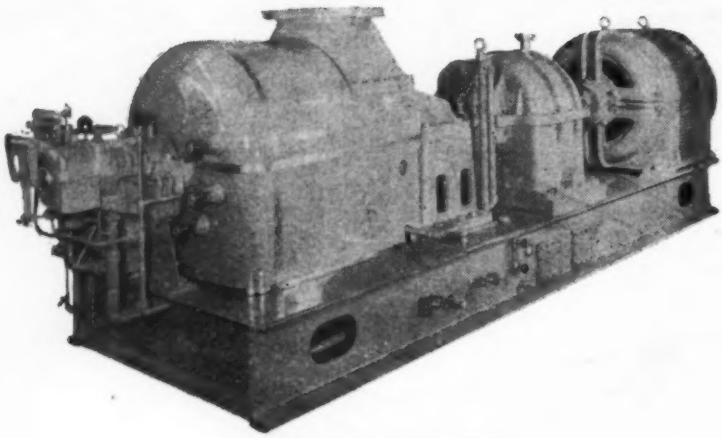
A "Research" Leather Belt on a F.L.A.T. drive will outlive a rubber V-belt on a corresponding drive by better than 2 to 1. Write Graton & Knight Company, 333 Franklin St., Worcester 4, Mass., for new, free Belting Manual.

GRATON AND KNIGHT

Research Leather Belting

from Graton & Knight's line of leather belting—the most complete for all applications. Manufactured under one control from green hide to finished product. Branches and distributors everywhere. Look under "Graton & Knight" in "Belting" section of Classified Telephone Directory or THOMAS' REGISTER.

MURRAY
TURBINE GENERATORS



500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycles alterating current on steam at 285# gauge, 700 degrees F., an exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

While "Package Type" units are furnished for export for installation in remote areas not previously supplied with power, similar designs can be made for industrial plants for main or standby power supply.

MURRAY *also produces:*

Mechanical drive turbines, horizontal and vertical
Reduction Gears Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

and his election to board of directors. He succeeds **C J Kenerson,** who retires as active head. **Stanley B Waring** is elected secretary-treasurer . . . **Edmund Hanlon** and **Martin Cozdenovich** join staff of engineers in marine dept of **Foster Wheeler Corp** . . . **Aeroil Burner Co** changes name to **Aeroil Products Co** . . . **B F Goodrich Chemical Co** appoints **T U Blake** chief engineer. **F V Morrison** becomes plant engineer at Port Neches.

Welding Research Council of Engineering Foundation announces appointment of **W Spraragen** as director. He will administer work of Pressure Vessel Research Committee now being organized . . . **Osborn Mfg Co** appoints **Robert Wier, Jr,** general sales manager of brush div . . . **F J Hood** was elected president of **Refrigeration Equipment Mfrs Assn.** He succeeds **Arthur B Schellenberg.** Other officers are **H F Spoehrer,** vice-president; **Edward M Flannery,** secretary; **J A Strachan,** treasurer and **R Kennedy Hanson** continues as executive secretary . . . **John M Rice** is appointed member of board for registration of professional engineers in Pa.

CURRENT AWARDS

Roxalin Flexible Finishes Inc and **Patterson-Kelley Co, Inc** have received the Army-Navy "E" flag. Four plants of **Westinghouse Lamp Div** received the first white star for their "E" flag. **Union Metal Mfg Co** has won their second white star.

Macwhyte Co and **Buffalo Forge Co** have been awarded three stars each. **Kewanee Boiler Co** received their fourth white star.

Foster Wheeler Corp and **Babcock & Wilcox** each received the fifth star for their "E" flags. **Nordberg Mfg Co** has been given a fifth award for Navy "E" pennant and the fourth award for the Maritime "M" pennant.

OBITUARIES

C Walter Spalding, manager power transmission machinery of Link-Belt Co, died suddenly on May 25.

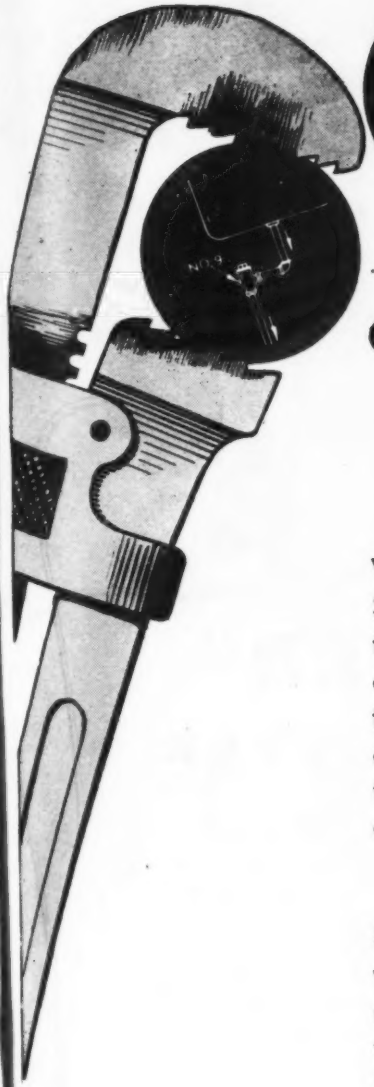
Edmund A Doyle, 64, consulting engineer for Linde Air Products Co and former president of American Welding Society, died suddenly at his home May 4.

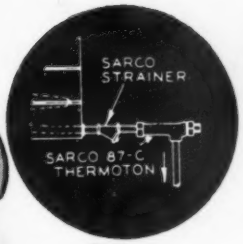
Charles G Heydon, 60, sales engineer for Wright-Austin Co died on May 9.

W A Russell, second vice-president of American Society of Heating and Ventilating Engineers and district manager for Hoffman Specialty Co, died May 12 at Osteopathic Hospital, Kansas City, Mo.

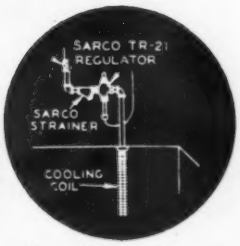
Clinton J Murtagh, 74, stationary engineer for Roberts & Cantwell Co, died recently at his home in Utica, N. Y.

Benjamin B Mills, 73, former engineer at Deer Island pumping station for Boston, Mass., and earlier with Boston Elevated Railway, died at Somerville on June 1.

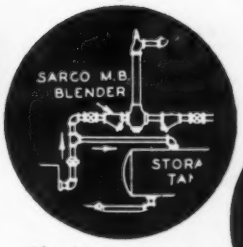




Strainer



Controlling cooling coil

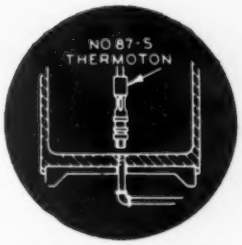


Blender on showers

Controlling solvent still

at the TWIST *of a* WRIST

Whenever a steam fitter breaks a line and inserts a Sarco strainer, a steam trap or a temperature control, he makes a permanent contribution to the efficiency of that part of the plant. Increased output of the steam equipment, dependable operation, increased quality of the product and the fuel savings that invariably follow will go on for years as a result of an hour's work.



Heating water with 87-S

IT'S TIME TO CONSIDER

Steam helped the war effort, but steam *economy* will be necessary for industrial survival in peace. All over the plant, you will find spots where the man with the wrench can easily insert inexpensive Sarco Steam Savers that were overlooked or not available at the time.

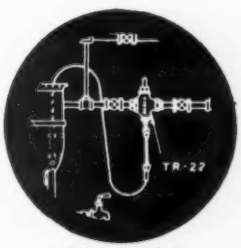
FT trap on cooker

HOW TO BEGIN

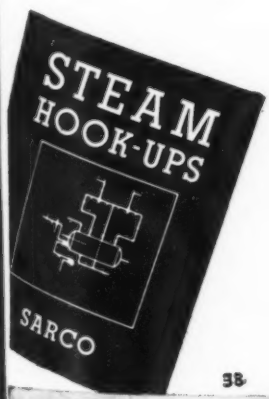
Easy does it. Call in the Sarco representative for a re-check on your steam engineering. Order a supply of the traps you need. Then, during shut-downs or long week-ends, the man with the wrench can slip them in. Before you realize it, your plant will be on the way to post-war competitive efficiency.

Then you can go after the temperature controls and some of the applications which are suggested in the circles above.

Bucket trap on engine supply



TR-22 control on Kettle



38

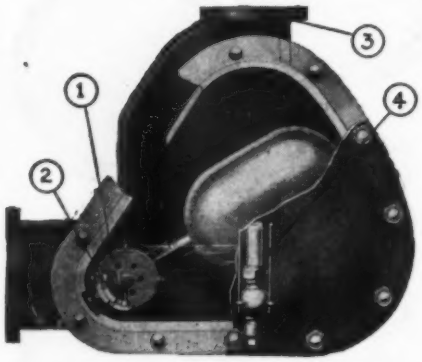
SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

Represented in Principal Cities

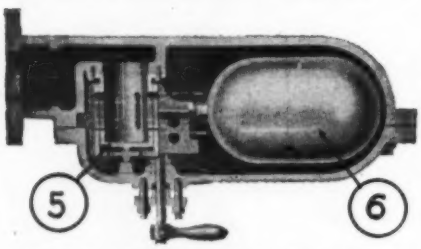
SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

Extraordinary Discharge Capacity



COCHRANE DRAINER



1 Valve absolutely balanced; does not bind or stick; water sealed; never leaves its seat; self-cleaning; has large ports for handling water rapidly and less operating pressure is required to expel condensate; pilot valves are unnecessary; no stuffing boxes, packings, springs or links; valve can be held open by handle on cover.

2 Valve Seat; a sleeve with longitudinal ports; removable after loosening screws.

3 Inlet at top; no possibility of trap becoming air bound; deflector prevents entering water from striking float.

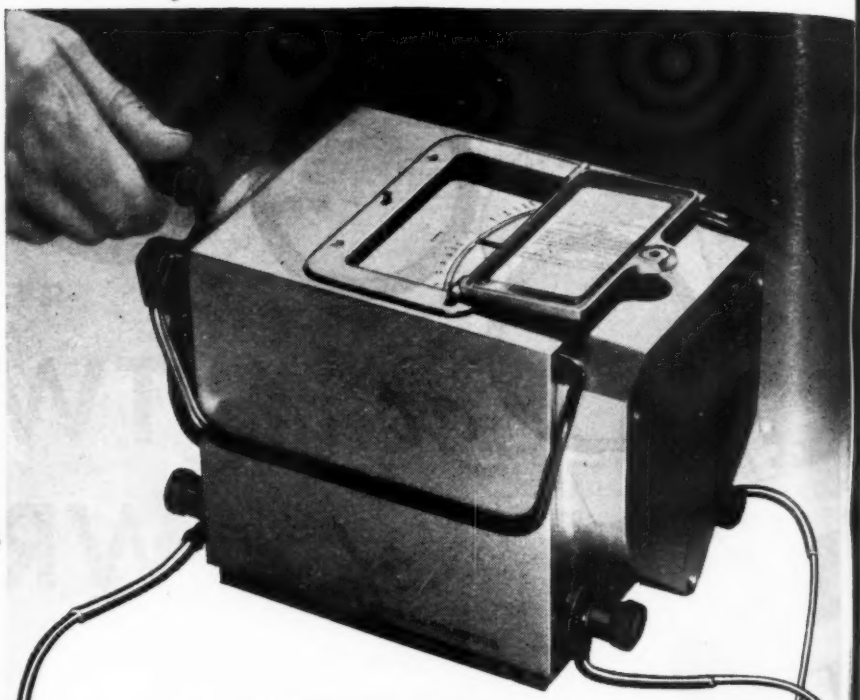
4 Gauge glass, with guards and try cock.

5 The Rotary Valve Seat is attached directly to float stem; one moving element.

6 Upon taking off cover, the float and attached valve lift out at once.

Write today for further particulars

COCHRANE CORPORATION
A DIVISION OF AMERICAN ENGINEERING COMPANY
3106 N. 17th St., Philadelphia 32, Pa.



"MEGGER"*
GROUND TESTER

The "Megger" Ground Tester measures resistance to earth of ground connections, quickly, easily and accurately. Simply connect the instrument to the installed ground and to two reference grounds, turn the crank and read resistance directly on the scale. Unaffected by polarization, electrolysis, stray earth currents or by the exact location or resistance of the auxiliary ground connections. Ranges from 0-3 ohms to 0-30,000 ohms.

"Megger" Ground Testers are invaluable for determining the nature of ground connections, and whether they are in condition to perform the service for which they are designed and installed. During the past 15 years these instruments have become standard equipment among many power companies, railroads, telegraph and telephone companies and industrial plants throughout the U. S. A. They are as rugged, reliable and simple in operation for ground resistance measurements as are our "Megger" instruments for testing insulation.

Write for illustrated Technical Bulletin on Ground Resistance Testers No. 1285-P.

*Trademark Reg. U. S. Pat. Off.

JAMES G. BIDDLE CO. · 1211-13 ARCH ST. PHILA. 7, PA.

TO KEEP POSTED!

JEFFREY CATALOG No. 778

Send for this 60-page manual which presents, both pictorially and schematically, various popular systems with related equipment for handling coal from receiving point to stoker—and removal of ashes — in any size plant.

THE JEFFREY MANUFACTURING COMPANY

922-99 North Fourth St., Columbus, Ohio

ESTABLISHED 1877

EUREKA "AMBEST" METALLIC PACKING

Keeps Good Rods Tight Without Scratching

Made of long pliable strands from anti-friction metallic alloy, lubricated and graphited—a universal packing wherever rods are in good condition—suitable for all pressures and temperatures up to 550° —lasts indefinitely.

One size which can be separated for use on any size rod or valve stem.

Send for sample for trial. Ask for 36-p. EUREKA PACKING CATALOG covering complete line.

PATENTED "EUREKA" TRADE MARK

EUREKA PACKING CO. 294-296 - 46th St. Brooklyn 20, N. Y.

Solving 80% to 90% of all tube-cleaning problems is easy. It can be done without recourse to special designs or equipment—if you have the right formula. A review of literally thousands of tube-cleaning problems presented to Wilson Engineers shows that in eight or nine cases out of ten, the problem can be solved by this simple formula:

1. *Choose the proper motor, cutter-head and accessory for the job.*
2. *Plan ahead—it will assure you of having enough of the right kind of tube cleaning apparatus on hand when you need it. You may save valuable down-time this way.*

It's easy to apply this formula when you have a copy of the Wilson Tube Cleaners Check List. It will help you choose the correct Wilson motor, cutter-head, brush, flexible shaft or other accessory to assemble a tube cleaner that will do your job—and do it quickly. In addition it contains a list of valuable suggestions on planning ahead, and maintenance and operation of tube cleaners. *Your copy will be sent on request.*

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MODERN TUBE-CLEANERS FOR THE PROBLEMS OF TODAY

TW-102

THOMAS C. WILSON Inc.
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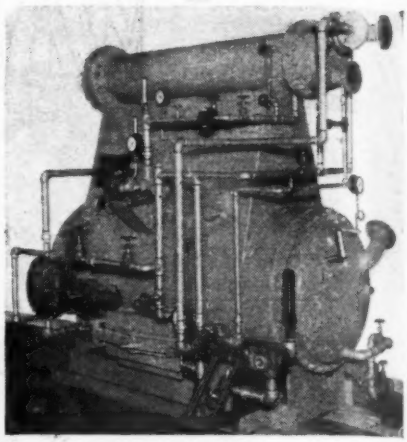
SELF-DESCALING EVAPORATORS



The self-cleaning tubes (U. S. Pat.) offer new advantages to power plants for producing feed water. When tube is heated difference in expansion of Monel strip and Admiralty tube causes it to curve. Cooling straightens it. Flexing shrugs off scale.

STEAM CONDENSERS

EVAPORATORS

Self Descaling (Patented) Cold Type

DISTILLERS • FUEL OIL HEATERS

FEED WATER HEATERS

COOLERS

Fresh Water Lubricating Oil

STEAM JET AIR EJECTORS

VENT CONDENSERS

HEAT TRANSFER PRODUCTS, INC.

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HTP

For example, we have supplied the complete fabricated piping for many steam and electric generating stations, under Lend Lease, for the Union of Soviet Socialist Republics.

SHAW

HIGH QUALITY, DEPENDABLE

Pre-Fabricated Piping Installations

Whatever your piping requirements — large or small — call on Shaw. You get the benefit of our 52 years of specialized experience in the Pre-Fabricated Piping field.

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Second and Lombard Streets
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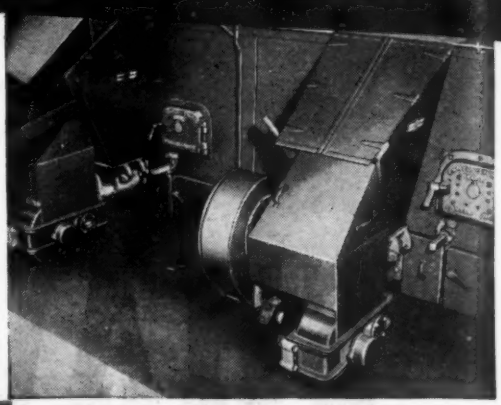
SINCE 1893 Known for Dependable Delivery and Quality PRE-FABRICATION AND INSTALLATION.

CANTON STOKERS *meet* TODAY'S

MORE STEAM . .

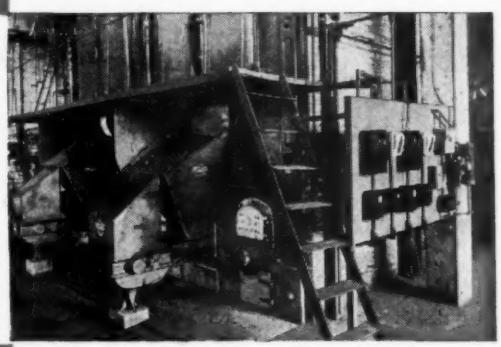
SAVING HUNDREDS OF DOLLARS ANNUALLY ON COAL ALONE

At Greve Park Inn, Asheville, N. Carolina, Canton Lo-Set Ramfeeds replaced another well known make Ramfeed Stoker, saving almost 50% of previous fuel bill, as Mr. Roberts, Chief Engineer, reports. The savings resulted not only because more efficient stokers were installed, but also because Canton helped re-engineer steam production and use in entire plant — another valuable Canton service.



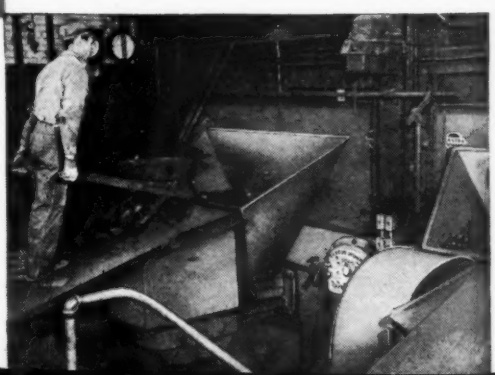
INCREASED STEAM OUTPUT OVER 50% WITH SAME BOILER

A detailed view of two Canton Vulcan Ramfeed Stokers showing the Synchronized Combustion Control panel at right. This large Eastern rendering plant, Norton and Company, Alexandria, Virginia, requires a maximum output of steam—depends on Canton Stoker firing to deliver 200% of the boiler rating. Cantons furnish steam at constant pressures, at the same time saving over 25% in fuel costs.



HIGHEST OPERATING EFFICIENCY WITH LOWEST MAINTENANCE COST

The E. & W. Dyeing Corporation, Paterson, N. J., require a huge volume of steam for their processing and heating operations. With increasing demand upon the two 250 H. P. boilers formerly oil fired, the change-over to coal firing with Cantons made possible efficient operation at 200% of rating and easily met the higher demand for steam. Mr. R. Ulinick, Purchasing Agent for E. & W., reports "completely satisfactory service from the two Vulcan Ramfeed Cantons with no repairs necessary since installation." Another example of Canton's dependable service and worthwhile savings.



CANTON . . . *the* ONLY STOKER *Guaranteed* 5 YEARS

Canton buyers receive this added Bond of Insurance against DEFECTS—and even WEAR itself. This is the best reflection of Canton in-built ruggedness and durability that means long stoker life and dependable operation.

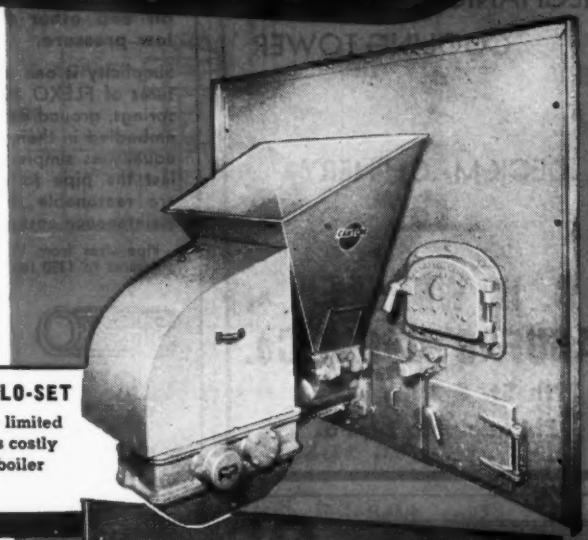
. . . and TOMORROW'S NEEDS

CANTON STOKERS

. . . from LESS COAL

FUEL AND MANPOWER SAVINGS MORE THAN PAY FOR CANTON INSTALLATIONS

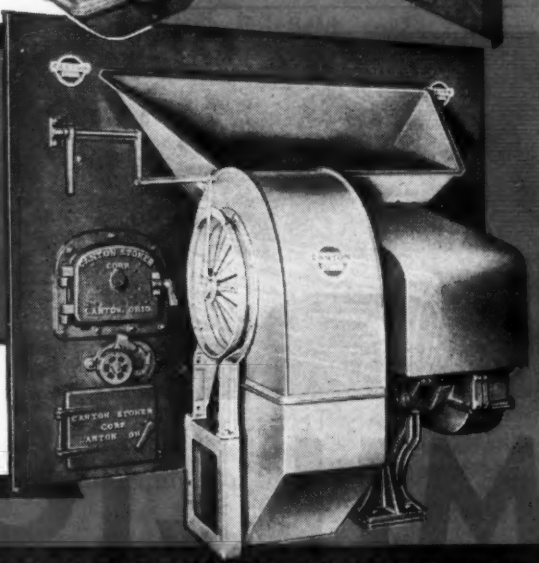
Fuel burning efficiency has never been more important than in the present emergency. Hundreds of Canton Stoker installations are making new records for saving fuel and manpower . . . keeping maintenance costs low. Canton Stoker's cooperative engineering, proper installation and trouble-free performance enable you to count on fuel and manpower savings that make the investment quickly self-liquidating.



CANTON LO-SET
Designed for limited space. Saves costly pitting and boiler changes.

54 TYPES AND SIZES OF CANTONS TO MEET EVERY NEED up to 800 H. P.

Every Canton Stoker installation is engineered for the specific job. The completeness of type and size range (with Canton's dependable Synchronized Combustion Controls) assures successful, economical performance. After thorough analysis of your needs by Canton engineers, you select the Canton model that will certainly meet all requirements.



CANTON VULCAN
Rugged ramfeed construction carries heaviest industrial loads continuously.

CANTON STOKER CORPORATION

741 ANDREW PLACE, S. W., CANTON, OHIO

SEND FOR COMPLETE FACTS NOW

Gentlemen:

---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediately

Name _____

Company _____

Address _____

City _____ State _____

Informative bulletins are available for detailed information on all Canton Stoker models. Our staff of Field Engineers is at your service for Free Consultation on Combustion Problems. Use the coupon or write, wire or phone us today.

C. H. WHEELER OF PHILADELPHIA

STEAM CONDENSERS

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MECHANICAL DRAFT COOLING TOWER

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DECK MACHINERY

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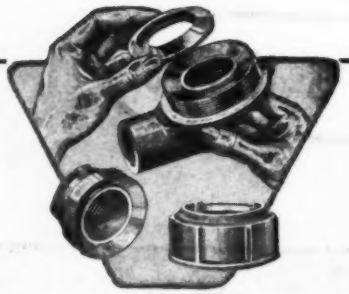

Just 4 Parts

FLEXO JOINTS

—are used wherever a flexible or swing pipe joint is required for conveying steam, compressed air, water, oil and other fluids under high or low pressure.

Simplicity is one of the outstanding features of FLEXO JOINTS as there are no springs, ground surfaces or delicate parts embodied in their construction. They are equally as simple to install and will outlast the pipe to which attached. They are reasonable in first cost and their maintenance cost is negligible.

Pipe sizes from ¼ inch to 3 inches for all pressures to 1350 lbs. superheated steam.

FLEXO

Write for complete bulletin.

FLEXO SUPPLY COMPANY Inc.

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ST. LOUIS (8) MO.

In Canada

S. A. ARMSTRONG LTD.,
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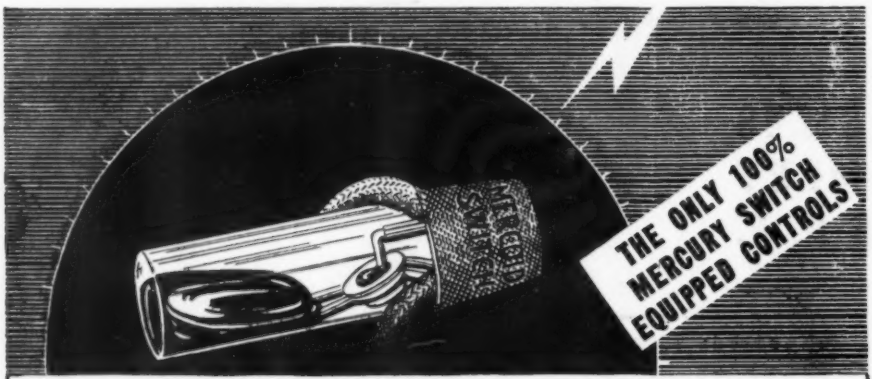
Toronto (5) Ont.



IT HAS THE ENDURANCE OF PROVIDING

MILLIONS

OF "MAKES" AND "BREAKS" IN THE ELECTRICAL CIRCUIT

The mission of a Mercoid Mercury Switch in an automatic control is to assure longer life and greater dependability—minimizing the need for attention after the control is in service. Mercoid Controls lend themselves to quick installation and adjustment, all of which are invaluable contributions in a time of national crisis.

Mercoid Switches, the distinguishing feature, used exclusively in all Mercoid Controls, are especially designed types of hermetically sealed mercury switches. They are not affected by dust, dirt, moisture or corrosive gases, nor are they subject to open arcing, oxidation, pitting or sticking of contacts—common causes of trouble.

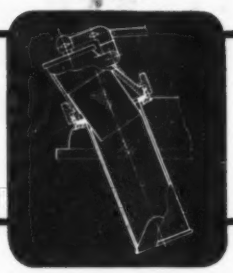
Keep these important facts in mind when selecting automatic controls.

MERCOID CONTROLS

FOR HEATING, AIR CONDITIONING, REFRIGERATION, AND INDUSTRIAL APPLICATIONS

THE MERCOID CORPORATION, 4205 BELMONT AVE., CHICAGO 41, ILL.

PROTECTOSEAL



SPOUT CROSS SECTION SHOWING FIRE BAFFLE

SAFETY CANS

REDUCE WASTE. Protectoseal Safety Cans eliminate spillage and waste common in handling fluids because the spout and cap are designed for easy, accurate pouring. The spring-closed cap is operated by the carrying hand for quick starting and dripless cut-off. The large spout is also the fill opening.

GUARD AGAINST FIRE. The double perforated-metal fire baffle in the spout prevents fire from reaching the contents of the can and safeguards against explosion. This baffle also acts as an efficient strainer and may be easily removed for cleaning when necessary. It does not hinder flow as a 5-gallon can may be filled or emptied in less than a minute.

STOP LOSS. Evaporation losses of volatile fluids, common in ordinary containers, are prevented in Protectoseal Safety Cans by the gasketed spring-held cap. Pressure on this cap is at the center, insuring a leak-proof seat. Heavy construction and reinforcing bottom shock ring prevent breakage of can and loss of contents from rough handling.

APPROVED. Protectoseal Safety Cans, made in 7 sizes from 1-qt. to 10-gal. capacity, are approved by Underwriters Laboratories and Associated Factory Mutuals. *Write today for complete data on the PROTECTOSEAL line of Fire Baffle Fill and Vent Fittings, Safety Cans, Plunger Cans, Thawing Cans, and Wash Tanks.*

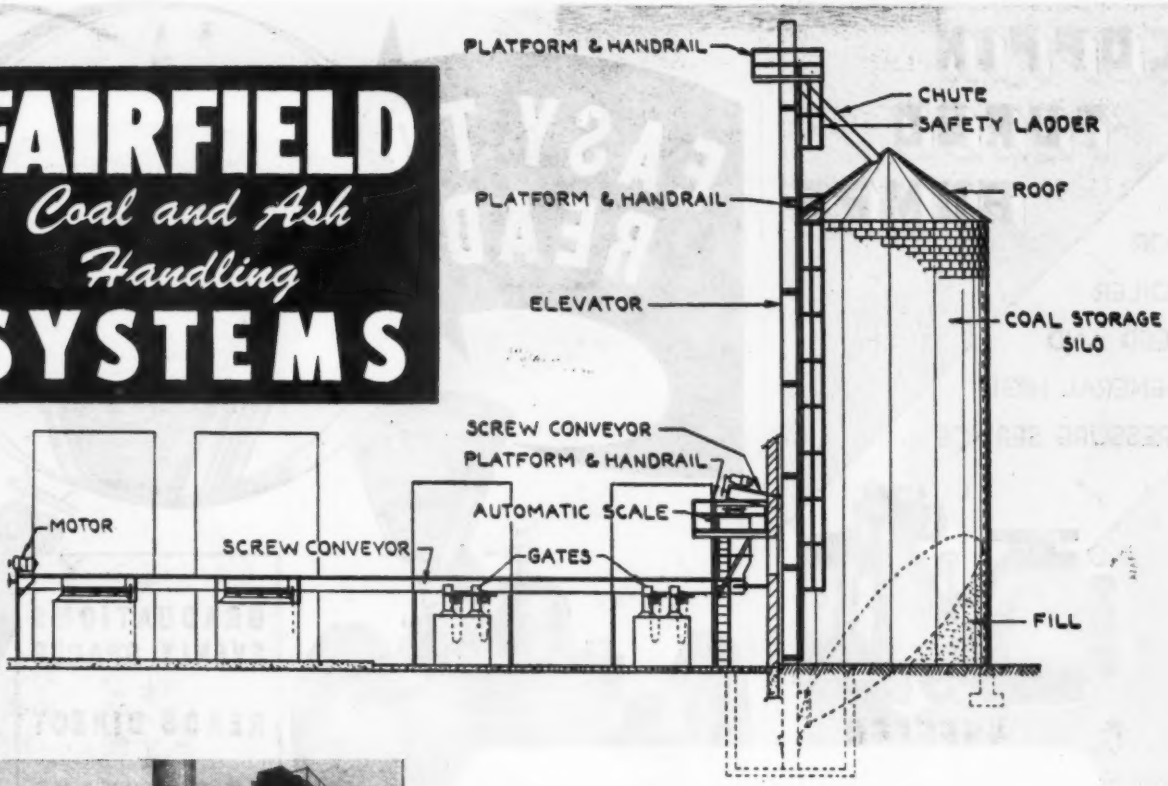
PROTECTOSEAL COMPANY

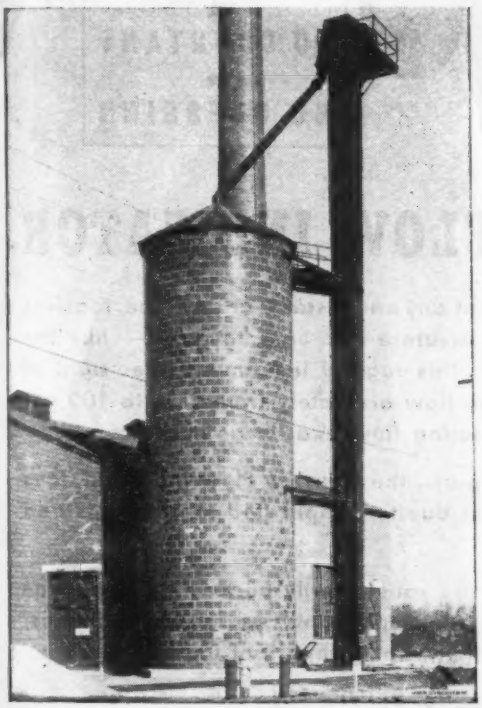
1938 SO. WESTERN AVE.

CHICAGO 8, ILLINOIS

PROTECTOSEAL

FAIRFIELD
Coal and Ash Handling SYSTEMS





Every installation is designed to fit your particular need

• **Illustrated is a typical Fairfield coal handling system showing how the coal is handled automatically from car to storage Silo to stoker or pulverizer.**

The Fairfield Silo is built of vitrified glazed tile—does not absorb moisture—air channels provide effective insulation—location outside the power plant eliminates dirt and dust from boiler room—takes up minimum space.

The system provides a choice of methods for handling coal from storage to stoker or pulverizer. The two most common are the screw conveyor, as illustrated bottom left, or a weigh larry.

The Fairfield system often includes complete ash handling equipment and silo for storage.

If you anticipate conversion to coal, addition to your present plant, or erection of a new plant, consult a Fairfield Engineer for dependable, efficient, low cost coal and ash handling. Catalog upon request.

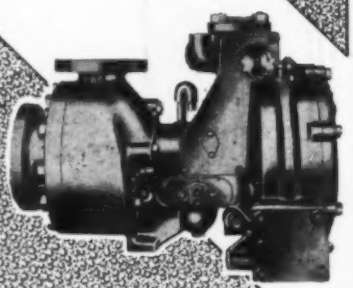
THE FAIRFIELD ENGINEERING CO.

Builders of Coal and Ash Handling Equipment

320 CHICAGO AVENUE • • • MARION, OHIO

COFFIN TURBO PUMPS

FOR BOILER FEED AND GENERAL HIGH PRESSURE SERVICE



THE J. S. COFFIN, JR., CO.
ENGLEWOOD, NEW JERSEY

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BLOW—CLEAN—SPRAY
with TORNADO

With its 1 h. p. G. E. motor, TORNADO Portable Electric Blower blows dust, dirt and lint out of motors, generators, shafting, etc. With bag and attachments added, it is convertible into a Vacuum Cleaner, for cleaning shelves, bins, floors and light salvaging. With other attachments, it can be made into a Sprayer, for spraying insecticides. Keeps equipment and plant clean for increased production and lower costs. Saves power—reduces hazards—lowers upkeep.

Request details and FREE TRIAL Offer

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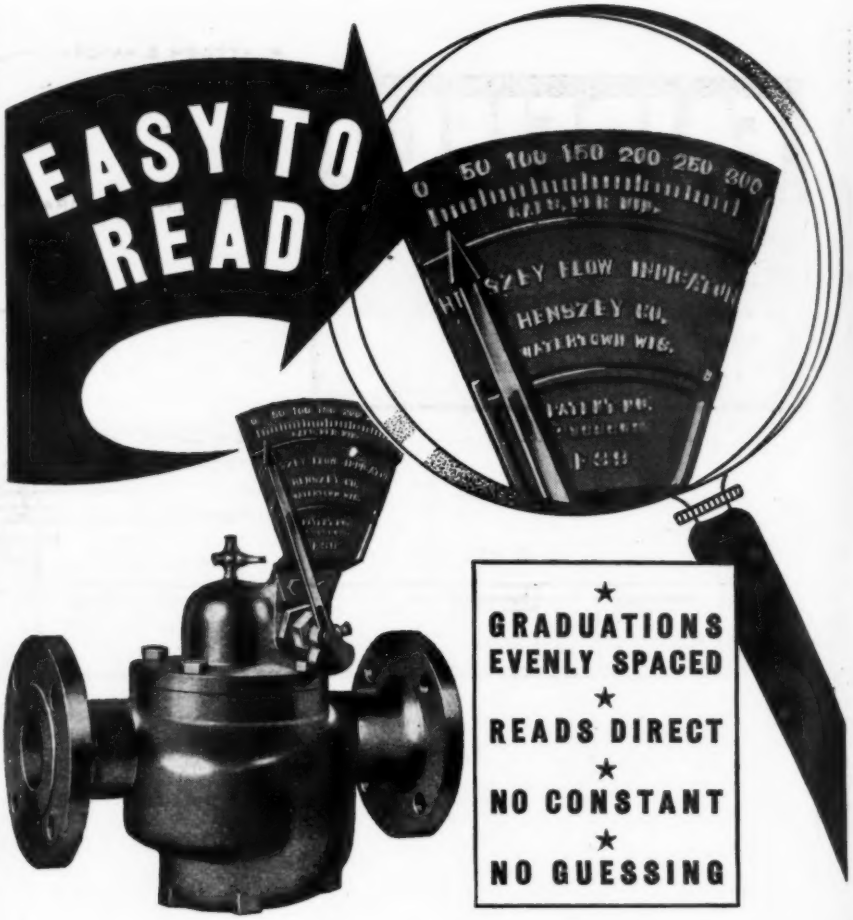
TORNADO

EASY TO READ



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HENSZEY FLOW INDICATOR

To know the rate of flow at any one instant, at any time, requires a flow indicator that is accurate and easy to read — like the Henszey Flow Indicator. This rugged instrument goes right in the line and indicates the flow accurately from zero to 100 per cent — indicating a pulsating flow exactly as it occurs.

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HENSZEY

FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

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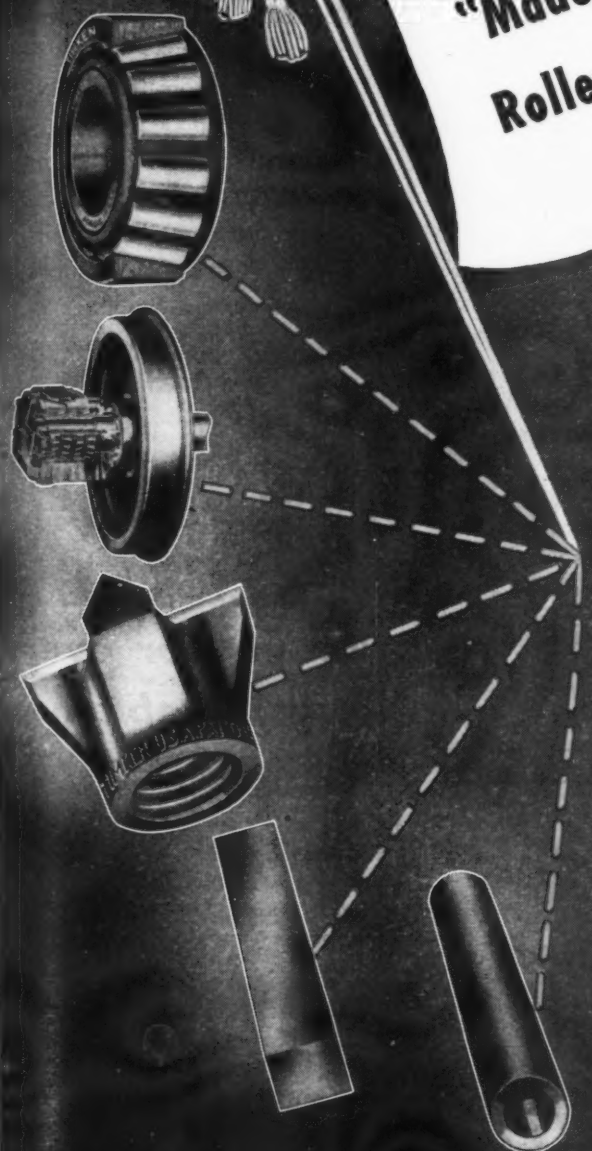
This Trade-Mark Means "Made By The Timken Roller Bearing Company"



Wherever you find it—on tapered roller bearings; alloy steel; seamless steel tubing; or rock drilling bits; it identifies a *genuine* Timken product with all that this implies—superior quality, performance and endurance.

These inherent advantages are not visible; they are revealed only in service, but you can be sure of getting them in full by making sure that the trade-mark "TIMKEN" is on every tapered roller bearing, every bar of alloy steel, every seamless steel tube and every rock bit you buy.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

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SAVE SECONDS HERE

SAVE HOURS HERE

A delay of only a second or two at each tube, can mount up to hours lost in cleaning a tubular unit. Roto Tube Cleaners, with operating air valve on the motor, enable the operator to control the equipment by himself. By eliminating delays due to signalling a helper at some remote point, valuable seconds are saved on every one of the hundreds of tubes cleaned, often saving hours on the entire job. Investigate the advantages which Roto Tube Cleaners offer. Write.

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Style 100

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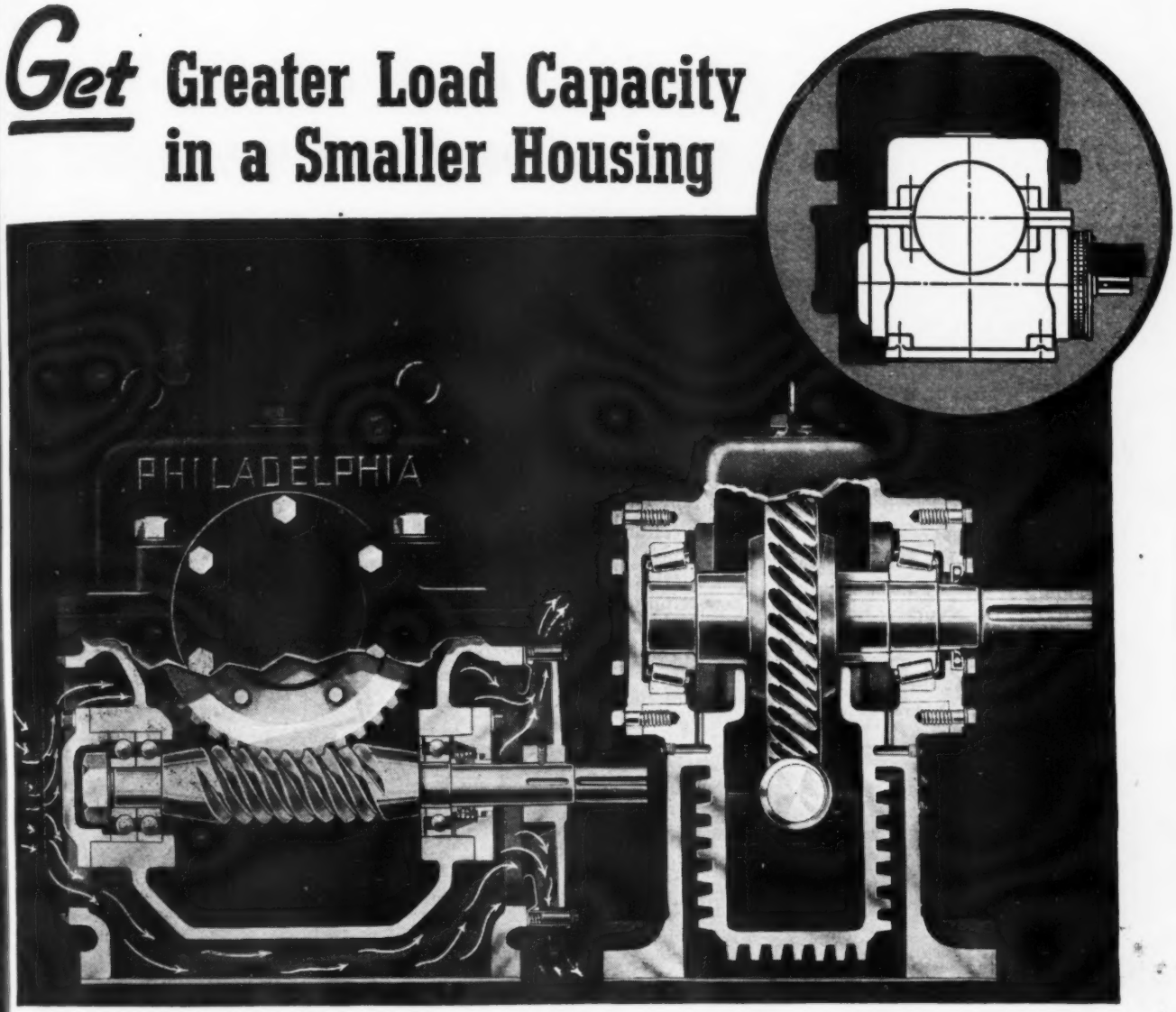
STOPS RUST

Get Greater Load Capacity in a Smaller Housing



...with the Philadelphia AIR KOOLED Worm Gear Speed Reducer

At the upper right is shown the comparative sizes of a size 675 Type AT standard unit (in blue) and a size 475 AirKooled unit. Both deliver 20 HP at 1750 RPM. Ratio 4 6/7 to 1.

The cut-away drawings show the double-walled, finned housing and the flow of air around the oil reservoir.

Considerable *space* and *weight* savings have been made possible by the design of Philadelphia AirKooled Worm Gear Reducers as compared with standard heavy duty type worm gear units.

The AirKooled design features a suction fan, mounted on the worm shaft, which draws air through the double-walled, finned housing. This dissipates generated heat, and thereby maintains a higher contact oil film strength and greatly increases the horsepower ratings at worm speeds of 580 and 1750 RPM. For all ratios at 1750 RPM the ratings are approximately doubled, so the AirKooled unit is about two sizes smaller than a standard unit of the same capacity.

Let us tell you what these savings can mean to you.

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ARMY E NAVY

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A sound "heart" is more than a masterpiece of accuracy; it must be non-porous, non-corroding, resilient and fatigue resistant. To control each of these essential characteristics, U. S. Gauge draws, forms and tempers its own Bourdon tubing starting from scratch with tube stock. It is, in fact, the only gauge manufacturer making Bourdon tubes from raw material.

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It's a fact that U. S. Gauges are standard in over 6 out of every 10 pieces of original equipment. You can credit that acceptance to U. S. Gauge's *Manufacturing Control*, a "Sherlock Holmes method" of watching raw materials, manufacturing, assembling, calibration, testing, and inspection. No gauge short of U. S. Gauge standards leaves the plant.

US Gauges

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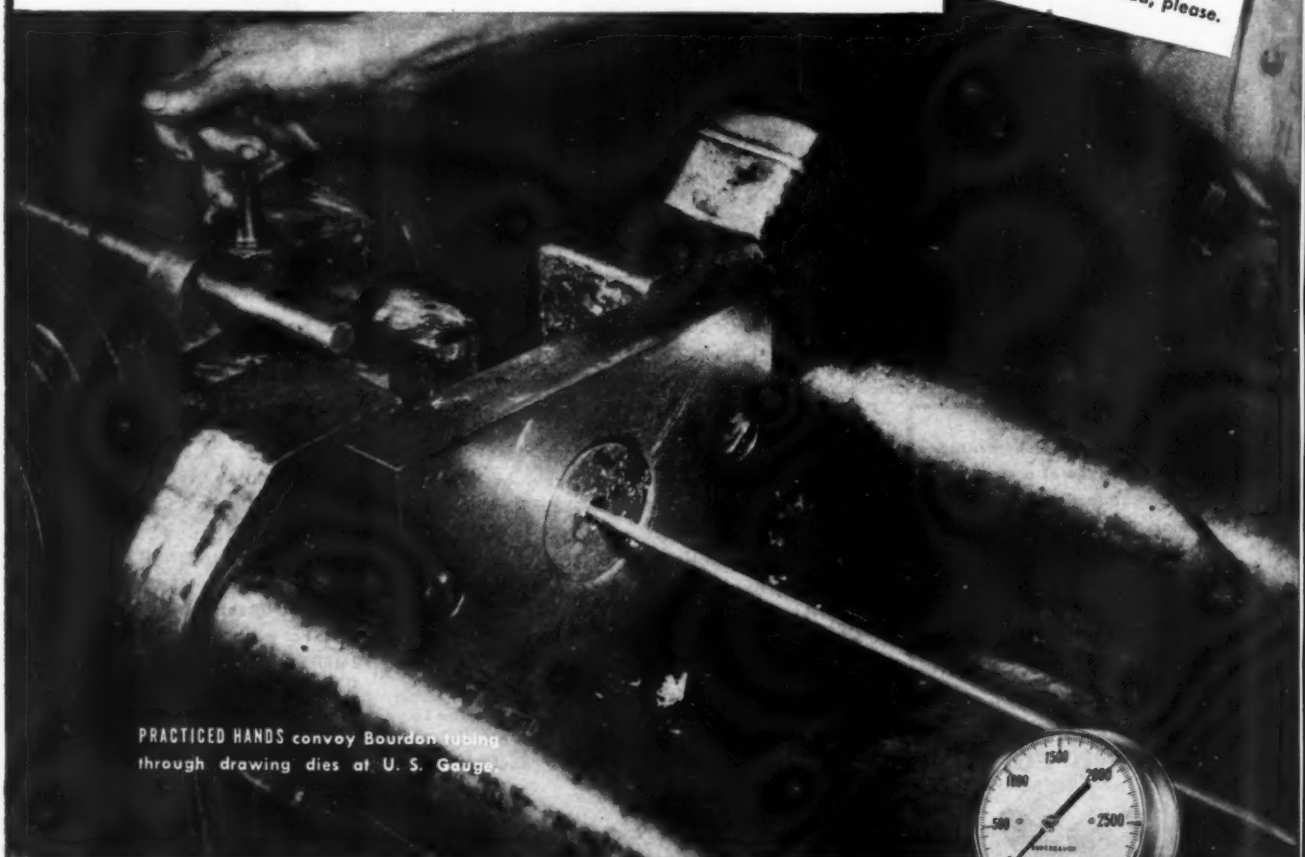

PRACTICED HANDS convey Bourdon tubing through drawing dies at U. S. Gauge.

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Manufacturers of Pressure, Temperature, Flow, Electrical and Level Measuring Instruments

U.S. INSTRUMENTS Tell The Truth

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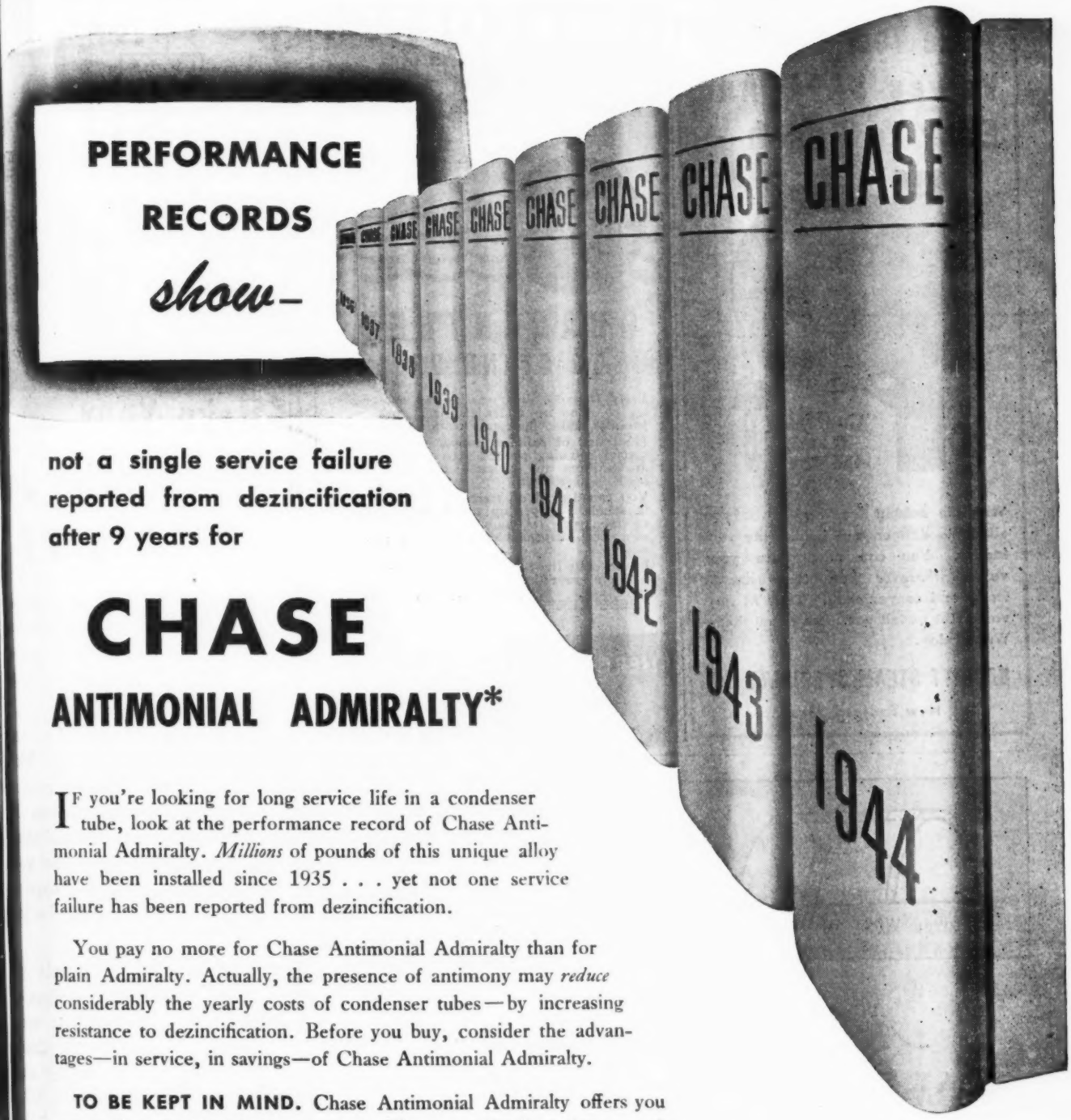

not a single service failure reported from dezincification after 9 years for

CHASE
ANTIMONIAL ADMIRALTY*

IF you're looking for long service life in a condenser tube, look at the performance record of Chase Antimonial Admiralty. *Millions* of pounds of this unique alloy have been installed since 1935 . . . yet not one service failure has been reported from dezincification.

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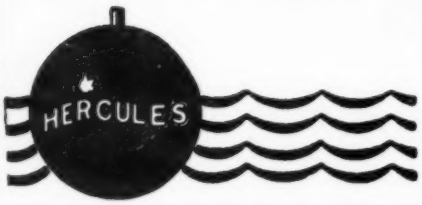

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Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

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A Smooth Pipe Contour
AT THE BASE OF EVERY WELD!

The Westport Patented Welded Joint provides a smooth pipe contour at the base of *every weld!* There are no icicles . . . no protrusions . . . and thus offers a method that actually strengthens your pipes!

This new method, especially suitable in the welding of heavy wall piping for high pressure and temperature conditions, is proving satisfactory in lines operating at 1250 pounds per sq. in. and 925 degrees F. total temperature steam service.

Mitchell's service includes this Westport method, which consists of a joint in which the ends to be welded are formed and machined to provide a U-shaped groove, joining the lips at the root of the weld by the oxyacetylene process and completing the joint by the usual electric arc procedure.

This provides greater flexibility in alignment of pipe, valves and fittings.

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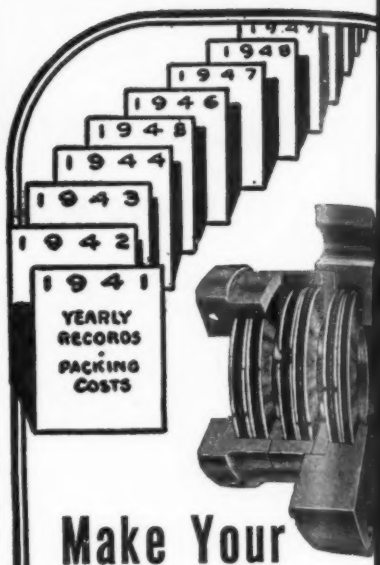
W. K. MITCHELL & CO., INC., Philadelphia 46, PA.



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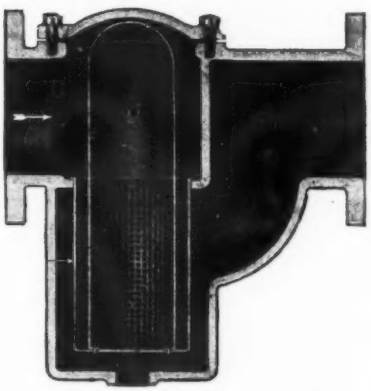

Type 330, Basket or Suction Strainers. Type 340, "Y" Strainer.

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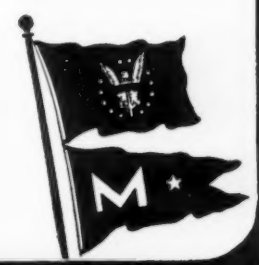

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Complete internal lubrication reduces friction, saves wear of both packing and equipment and keeps the packing soft and resilient for extremely long periods of time.

The result is long, economical service, saving time, material and trouble.

There is a PALMETTO Packing available for every condition of service.

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PALMETTO for steam, water, air • PELRO for oils • CUTNO for alkalis • SUPER-CUTNO (blue asbestos) for acids • KLERO for foods

Self-Lubricating **PACKINGS**

Keep Steam *Working* Until *"Exhausted"*

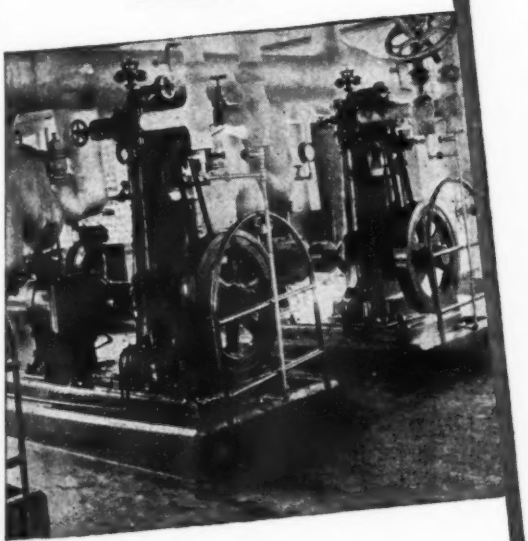
Power wasted by passing live steam through a pressure reducer makes your heating cost higher than it should be. This lost power can be recovered and a saving effected by first using the steam to drive a Troy-Engberg Steam Engine.

The energy thus converted can be utilized to drive a generator, stoker, blower, compressor or other equipment. After being used in this manner, the steam at proper pressure goes on to do its principal job of heating.

Savings in power costs — either direct or through fuel economies — quickly repay your entire investment sometimes in as little as one year.

If you use low-pressure steam in your plant for heating or processing, investigate the possibility of using Troy-Engberg Steam Engines to provide By-Product Power.

TROY ENGBERG



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Established 1870
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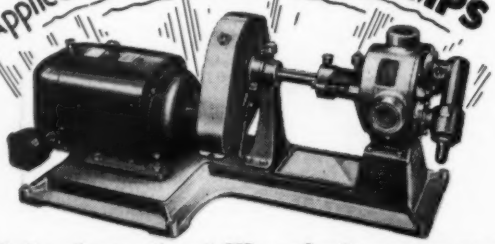
WIDER and WIDER Spread The Applications of VIKING PUMPS



WITH the demands of War placing new responsibilities on Viking Pumps, coupled with Viking's largest selection of Rotary Pumps in the world, the net result has been a wider and still wider application for Vikings.

Take advantage of this wealth of experience. If you have a rotary pumping problem, ask Viking about it today.

Write for Special Folder SP-123w which illustrates many styles and sizes available, as well as listing and describing 30 special bulletins, any of which will be sent to you free on request.

VIKING Pump COMPANY
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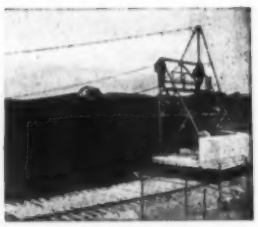
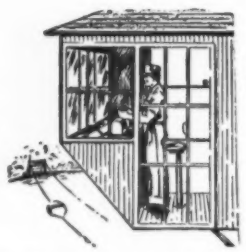


Picture shows a Sauerman Scraper System with mobile tail tower handling a 40,000-ton stockpile on a semi-circular area 280 ft. in radius. Powered by an 80 hp. motor, the scraper stores or reclaims an average of 100 tons an hour.



In his station overlooking stockpile, operator has "push-button" control of entire operation of scraper, including travel of tail tower seen in background.

STORE MORE COAL

with less labor!

—at lower cost!

SAUERMAN Scraper Coal Storage Systems are economical, flexible, dependable, and will pile a maximum tonnage in any area.

One man operation, under clean, attractive conditions, assures thrifty handling of every ton of coal in and out of storage.

Sauerman equipment will build a perfect, homogeneous pile as high as desired. Avoids segregation and combustion hazards of air pockets.

Tell us about your problem and our engineers will give you their idea of a solution.

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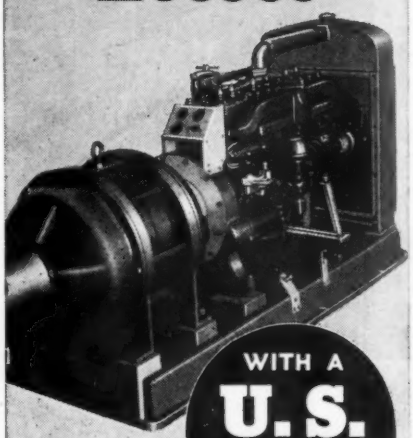

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It is wise to safeguard electric ovens, furnaces, electrolytic processes and other crucial operations with stand-by service to avoid losses of power failure.
We specialize in the building of this type of Emergency Electric Plant equipment and have successful installations in varied applications throughout the nation. Write for specific details.

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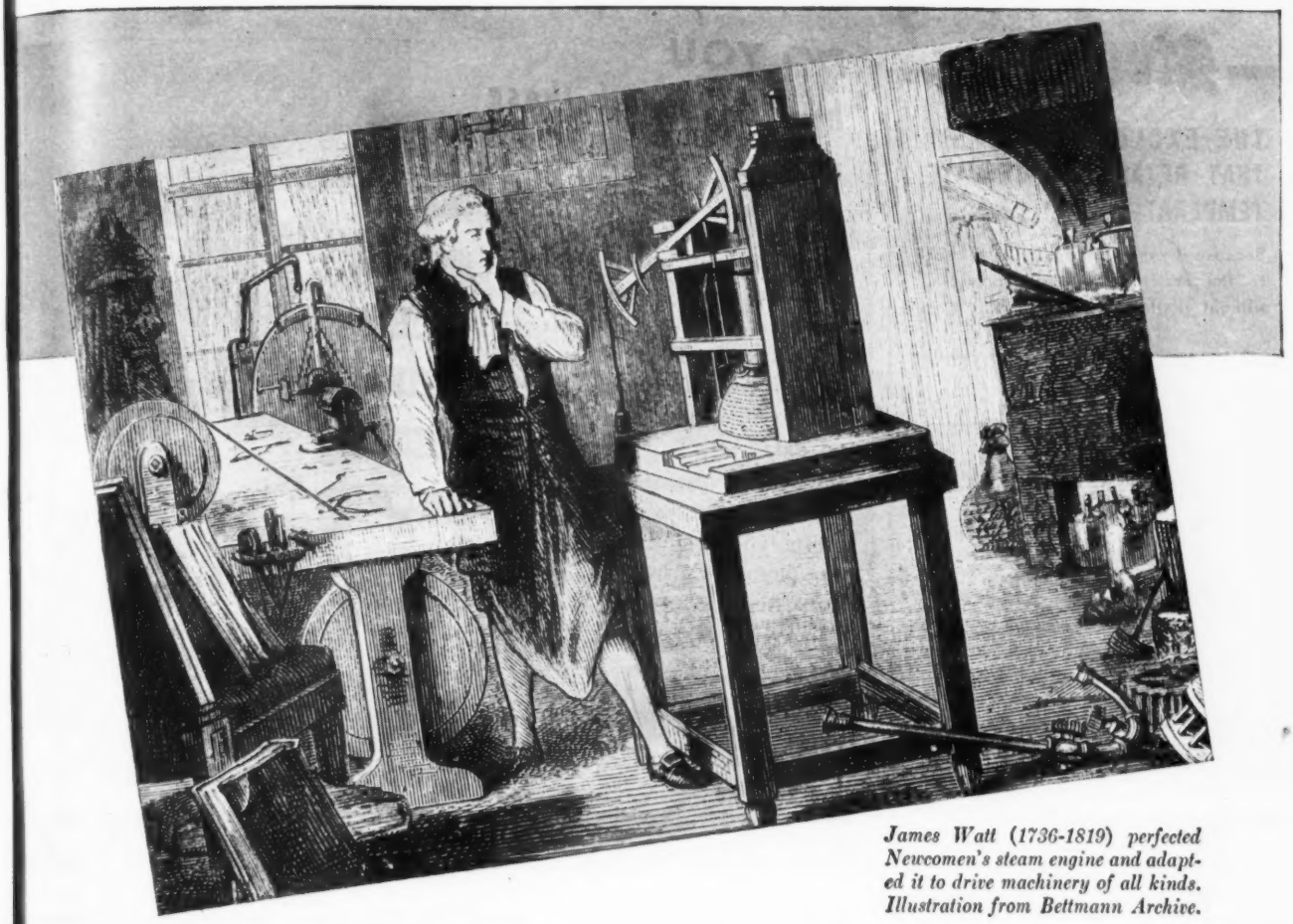


James Watt (1736-1819) perfected Newcomen's steam engine and adapted it to drive machinery of all kinds. Illustration from Bettmann Archive.

JAMES WATT Perfected the Steam Engine in 1781

HEVRON PACKING is one of the many arlock quality-controlled packings. The ique hinge-like design allows the packing expand and contract—it adjusts itself tomatically to variations in pressure.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal, Que.

"One Sunday morning" wrote James Watt, "the idea occurred to me that steam would expand and rush into a vacuum." At that moment the modern steam engine was born in Watt's brain—a flash of genius for which all mankind is thankful.

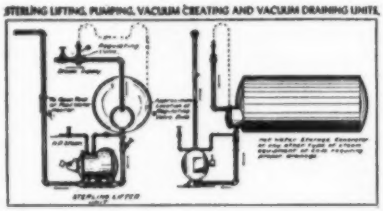
About the time steam engines came into general use nearly a century later, Garlock began manufacturing packings to improve their operation—and today Garlock supplies packings and gaskets for millions of engines now in use throughout the world.

Garlock

Sterling

THE EXCLUSIVE SYSTEM THAT RETAINS CONDENSATE TEMPERATURE . . . . . .

Because it sends the condensate back to the boiler room under pressure, without venting to atmosphere.



Sterling's Closed System then feeds the boiler with only a nominal line drop in temperature, giving maximum efficiency, economy and reducing boiler maintenance.

You Need To Save Fuel Now

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(Templeton Mfg. Co.)
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Hyde Park, 36, Massachusetts

DO YOU *handle any of these materials in bulk?*

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• Beaumont Skip Hoists are ideal for high lifts and for handling heavy, abrasive and bulky materials. One or two buckets operating in heavy I-beam tracks, either counterweighted, un-counterweighted or balanced. Automatic and semi-automatic operation. All capacities and sizes. Write outlining your requirements for our engineer's recommendations and quotation.

Heavy I-beam Tracks

In the installation illustrated, the skip hoist handles both coal and ashes alternately, in same bucket, and discharges to either coal or ash bunkers.

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DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

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THERMODYNAMIC PROPERTIES OF AIR

Including Polytropic Functions

By JOSEPH H. KEENAN and JOSEPH KAYE

The expansion of the science of heat engineering makes this new book increasingly valuable to mechanical engineers whose work involves heat problems. Here is provided a working table of the thermodynamic properties of air which will simplify many computations. The tabulated properties eliminate many laborious integrations. Interpolation can often be dispensed with, or greatly simplified.

SEE HOW THESE FEATURES WILL SPEED AND SIMPLIFY YOUR WORK:

Clarifies the one uncertain factor in the equation of state for air, T.
Provides a "steam table" for gas turbines and compressors—more convenient than a steam table.
Permits ready computation with allowance for variation in specific heat.
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Eliminates practically all interpolation by presenting Table I in minute detail. Even for greatest precision, no double interpolation is necessary.

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Please send a copy of Keenan & Kaye's THERMODYNAMIC PROPERTIES OF AIR on ten days' approval. At the end of that time, if I decide to keep the book, I will remit $2.25 plus postage; otherwise I will return the book postpaid.

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P-7-45

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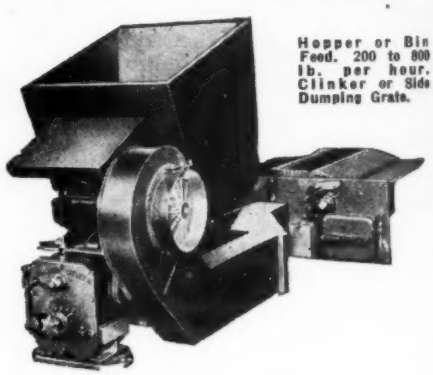
FREDERICK Stokers SAVE . . . TONNAGE LABOR and SHIPPING



Hopper or Bin Feed. 200 to 800 lb. per hour. Clinker or Side Dumping Grate.

Built to stand up under the hard usage of industrial installations, the Frederick Stoker is highly regarded and widely used in industry.

Frederick design insures thorough fuel combustion; maximum utilization of heat-giving gases, which results in lower coal consumption. Corresponding conservation of labor is thereby effected, and less coal transported releases shipping for other vital needs.

Frederick engineering features—the fully active grate surface . . . no dead plates . . . continuous speed type transmission and completely enclosed wind boxes and mechanism—are described in our Stoker catalog. Send for it.

WE ALSO MANUFACTURE fine Centrifugal Pumps especially designed for efficient service in a specific industry. Engineering consultation available without obligation.

THE Frederick IRON & STEEL CO.
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STOKER SPECIALISTS SINCE 1918

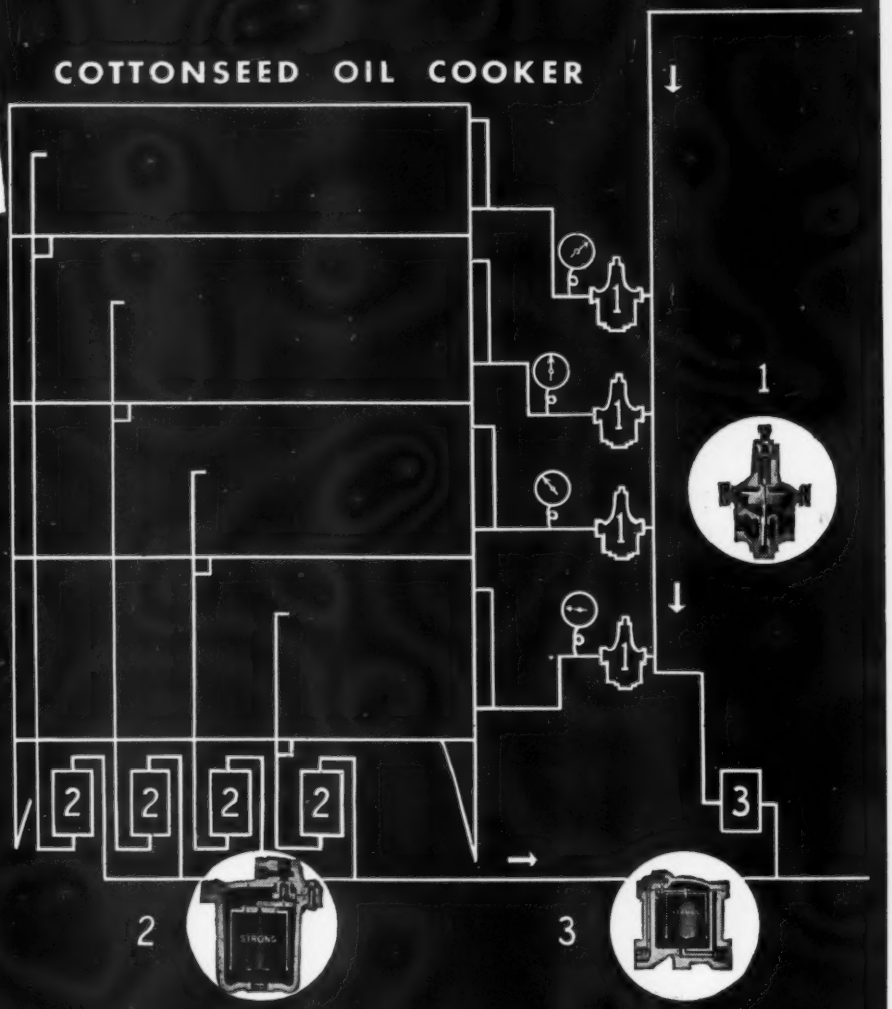
Double Problem in Steam

1 Control and variation of temperatures in four steam sections.

2 Correct drainage to insure maintenance of cooking temperatures.

HERE'S STRONG'S *Suggestion:*

1. Since temperature varies directly with steam pressure install Strong's variable pressure reducing valves (Type K with Anum-Metl disc and seat and integral strainer) on inlets of each section. Pressure gauges in reduced side of line provide easy visual control, eliminating maintenance of temperature regulator bulbs.
2. Use Strong's Series 80 inverted bucket traps with Anum-Metl valves and seats to drain each section. Insure positive drainage and uniform cooking of meats.
3. Small Strong series 70 inverted bucket trap with Anum-Metl valve and seat drains main header, insuring a constant supply of live steam at each reducing valve.



Time-temperature processes depend on both!

Cottonseed cookers, in common with all time-temperature steam processes, require both accurate pressure control and complete, automatic condensate removal. In this case bright, high-quality oils depend upon how accurately equipment operates.

Knowing the problems involved, and having the steam specialties needed to solve them, permit Strong steam engineers to give unbiased, practical recommendations that insure satisfactory operation of your time-temperature processes. This calls for close attention to drainage equipment to fit the variables in each installation, determine peak loads, time required to reach temperature, etc.

For any trap need, open or inverted bucket, float, float and thermostatic—in cast or semi-steel, forged or welded construction—call on

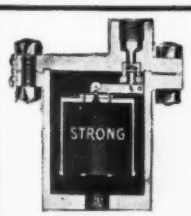
STRONG, CARLISLE & HAMMOND COMPANY

Cleveland 13, Ohio

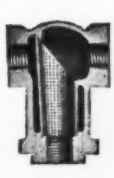
REG. TRADE MARK

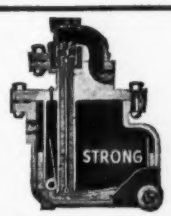
OTHER **STRONG** STEAM SPECIALTIES

ANUM-METL Reg Trade Mark



Welded steel trap


Strainer



Open bucket trap

ADAMANT
FIRE BRICK CEMENT

MAINTAIN FURNACE PRODUCTION
with longer lasting ADAMANT Linings

Lay up linings with ADAMANT — its higher bonding strength (see below) protects the structure at the joints . . . where failure usually begins. Keep furnace maintenance costs down — keep production up . . . save on repairs and replacements— use ADAMANT.

ADAMANT
Stronger by Test

Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature; 1270 lbs at 2600° F. Adamant has a P.C.E. of 3000° F. plus. For more details, write

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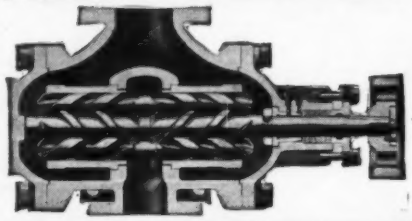

THE PUMP *without* PULSATION

The steady, uniform flow produced by the continuous turning of the rotors in an IMO pump is ideal for oil burners, hydraulic and other service requiring an even, pulsation-free flow.

For further information, write for Catalog I-124-P

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Control
OF CORROSION...

Taylor
LIQUITROL

THE MODERN METHOD TO CONTROL pH, CHLORINE AND PHOSPHATES

Today's expanded production demands call for a quick on-the-spot method to check and control corrosion, that ever present danger in boilers that can cause slow-ups and even plant shut-downs.

Taylor Liquitrol is the modern method that enables plant engineers to make accurate determinations of pH and chlorine in 60 seconds and phosphate in 2 minutes, *in any part of the plant.* No getting anything ready . . . no checking equipment . . . no assembling "extras."

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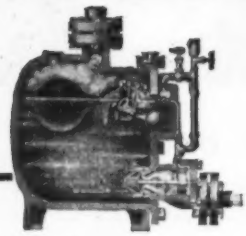
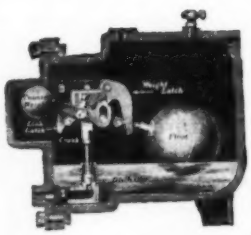
YORK & ROGERS FORGE RDS. • BALTO. MD.

★
NICHOLSON
TRAPS



Safeguard
Steam-Using Units

Depend on the unequalled discharging capacity of Nicholson Steam Traps to not only promote the efficiency of engines, pumps and turbines, but also to perform the vital duty of protecting them against sudden slugs of water. The enormous capacity and quick, positive action of Nicholson Traps have won them the wide approval of both power and maintenance engineers. . . . Available for every power and process application.

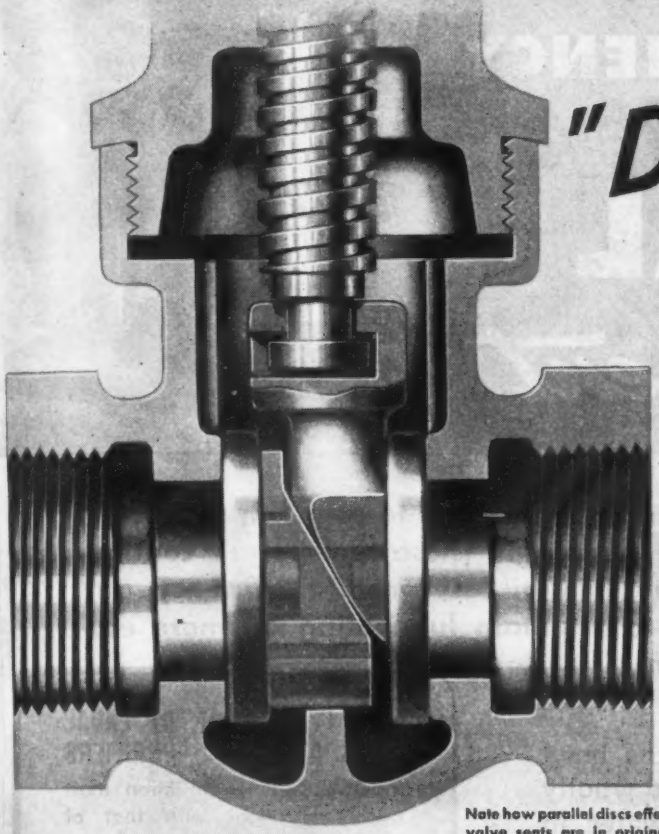


Write for Catalog 444 or See Sweet's

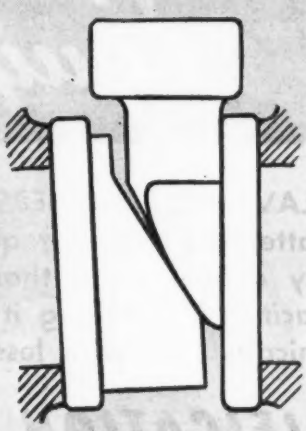
W. H. NICHOLSON & CO. 125 OREGON ST. WILKES-BARRE, PA.

Valves • Traps • Steam Specialties

DARLING...the valve that can give you "DROP-TIGHT" SEATING...

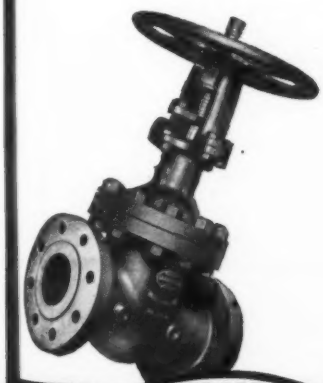


Note how parallel discs effect tight closure when valve seats are in original parallel position.



This greatly exaggerated diagram shows how the curved face of the upper wedge allows the discs to fit against seats, "unparalleled" by valve body distortion.

Darling manufactures a quality line of gate valves for long service—in parallel seat or tapered seat—slotted or solid wedge types—for service pressures up to 3000 pounds. Valves are available in cast iron, bronze, cast steel, forged steel, corrosion resisting and special alloys. Darling also manufactures check valves, compression type fire hydrants, motor and cylinder operated valves, and accessories.



THERE is one gate valve design that insures "drop-tight" seating, year after year. It is the unique Darling design. Darling's fully revolving double disc parallel seat gate valve provides:

1. ADAPTABILITY—Any valve can close tight the day before it is installed. But the day after is another story. Pipe out of alignment and bolting strains distort valve bodies. Pressure and temperature changes and other operating strains force valve bodies out of shape, too, so that gate and seats do not remain parallel.

To compensate for "unparalleled" seats, in the Darling valve wedging assembly a straight or tangent surface on the lower wedge acts on a curved or "radius" surface on the upper wedge. So no matter what position valve seats reach in years of usage, the Darling twin discs make perfect closures.

2. UNIFORM WEAR—The twin discs are free to revolve 360°, seating in a different position each time the valve is operated. Wear on discs and seats is uniform, making possible tight closing year after year.

3. INSTANT RELEASE—The four simple parts of the valve assembly—two discs, two wedges—release at the first fractional turn of the stem to open. The gate is immediately free to rise with little or no friction.

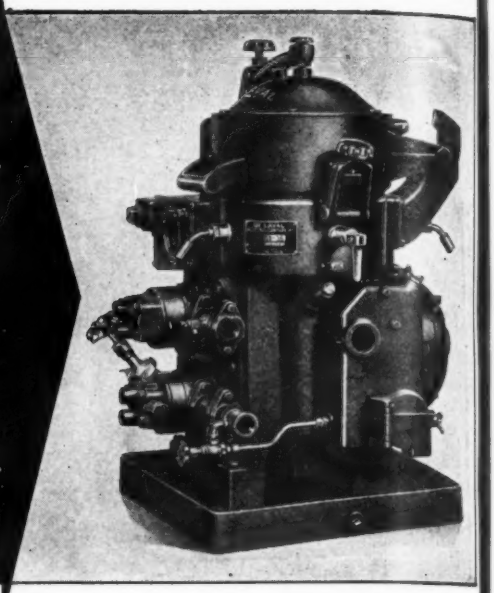
For over 40 years engineers have found that Darling Valves give "drop-tight" shut-off, long life and low maintenance.

NOW—when maximum uninterrupted production is all-important—you can safeguard it by installing Darling Valves. Later, when low-cost operation and maintenance are vital, you will be all set with valves that help you keep costs down and help you compete in postwar markets.

TRADE DARLING MARK

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

Higher, MORE UNIFORM PURIFYING EFFICIENCY *with* DE LAVAL *Equipment*



DE LAVAL OIL PURIFIERS, once started, can be left to run with practically no attention save infrequent bowl cleaning. These centrifugals continuously deliver more thoroughly purified oil at constant *efficiency* and *capacity* . . . making it possible to maintain lubricating oil more economically . . . with less attention.

PURIFICATION of oil in the bowl of a De Laval Oil Purifier is accomplished wholly by means of centrifugal force — any water in the oil discharges continuously from the machine and dirt is stored outside of the zone of purification. At no time can either removed dirt or water impair the effectiveness of purification — dirty oil is exposed to the same centrifugal force from the time a run starts until the dirt-holding space is completely filled.

Nor is it necessary to stop a De Laval centrifugal during a run to renew functional parts — the "constant efficiency" feature which is an inherent result of De Laval bowl design enables oil to be maintained in a more uniformly pure condition with less lost time and at maximum economy.

Learn how the other advantages listed at the right can benefit you. Write for additional information.

ADVANTAGES OF DE LAVAL LUBRICATING OIL PURIFIERS

Maintain oil in condition most nearly identical with that of new oil

•

Economical to operate

•

Constant high purifying efficiency — without renewal of functional parts

•

Remove both enemies of good lubricating oil performance: water and dirt

•

Provide maximum protection to power units

•

Give long, trouble-free service

•

Lower maintenance costs

•

Self-draining purifier bowl makes for easy cleaning

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
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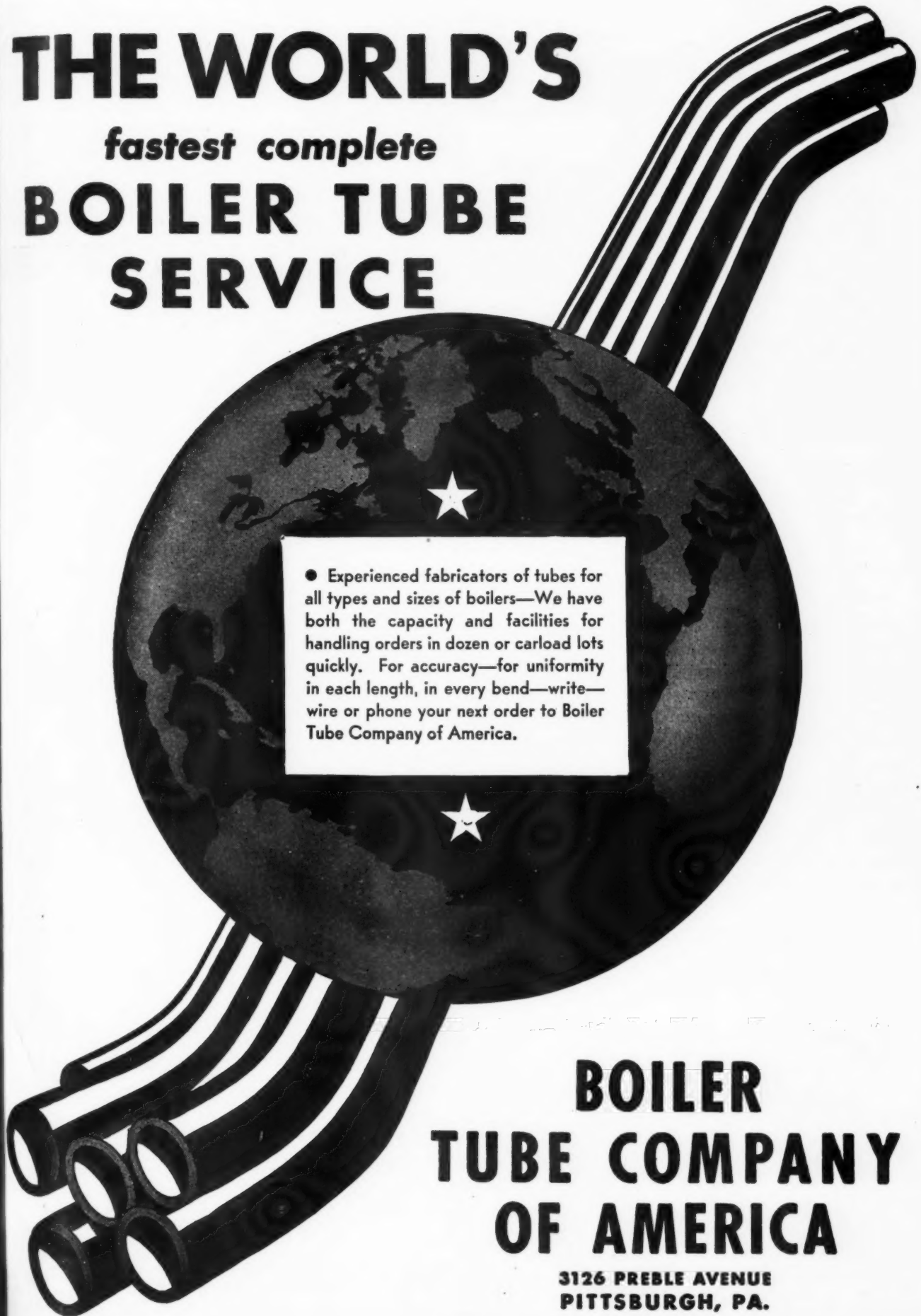
LUBRICATING OIL PURIFIERS

THE WORLD'S

fastest complete

BOILER TUBE SERVICE



● Experienced fabricators of tubes for all types and sizes of boilers—We have both the capacity and facilities for handling orders in dozen or carload lots quickly. For accuracy—for uniformity in each length, in every bend—write—wire or phone your next order to Boiler Tube Company of America.

BOILER TUBE COMPANY OF AMERICA

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"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

KENNEDY METAL IS STRONG

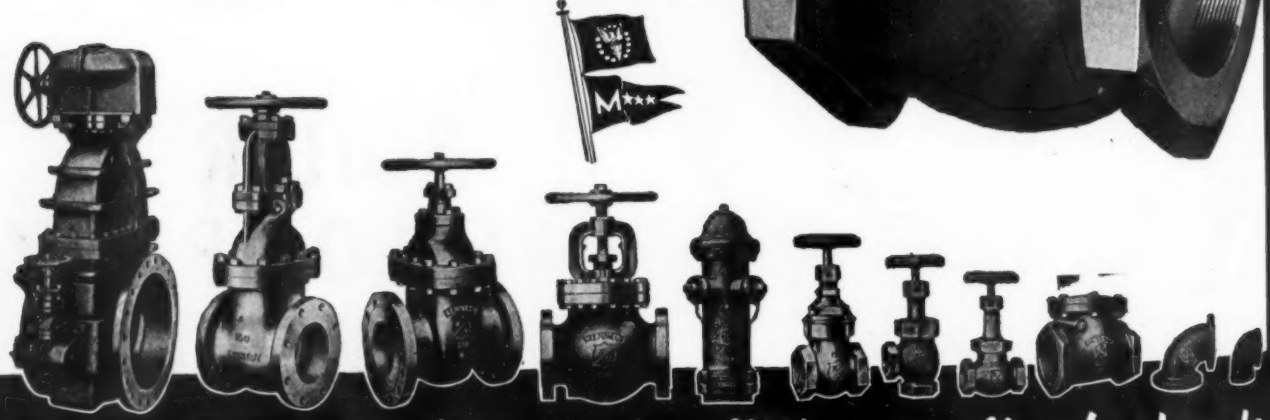
because these fibres are weak

The fibres you see in the small circular reproduction of a microphotograph (enlarged 100 times) of Kennedy iron body valve metal section are graphite.

When these fibres are long, wide and connected with each other, as in many examples of ordinary cast iron, the metal structure is coarse, irregular, weak and brittle. However, the short, thin, separated graphite fibres of the special metal used for all Kennedy iron body valves, permits a dense, uniform tough structure which is far stronger than ordinary cast iron.

This is why Kennedy valves excel in strength, as they also excel in features that provide greater efficiency and convenience of operation. Learn ALL the Kennedy iron body and bronze valve details and you will quickly see the advantages of standardizing on these valves for all standard services.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK



KENNEDY *valves... pipe fittings... fire hydrants*

Alco Prefabricated-Pipe Service

Expert Pipe Benders for All Export or Home Needs

To handle a pipe-prefabricating job right—quality, price and delivery—is a tough job, especially for export.

Bending and heat-treating are no easy arts. But for export—there is the added trouble of boxing. It takes a great deal of experience to box prefabricated pipe involving complicated bends. ALCO does it in a way that saves ship space and gets you the lowest possible shipping charges.

Large, completely equipped ALCO shops produce prefabricated piping to close tolerances in all alloys. Its facilities include stress-relieving and annealing furnaces, big bending tables and machines, modern apparatus for X-ray inspection, its own special boxing department.

ALCO's thorough understanding of proper marking ensures quick identification essential to lowest-cost installation.

ALCO knows every custom, rule and regulation affecting prefabricated-pipe shipments for export—meets your boat schedules—smooths the progress of your prefabricated-pipe job *all the way.*

Also available — ALCO Electric-welded Steel Pipe

In addition to prefabricated piping, ALCO makes electric-welded steel pipe from 20-inch to 120-inch diameters in lengths up to 40 feet.

American Locomotive

ALCO PRODUCTS DIVISION

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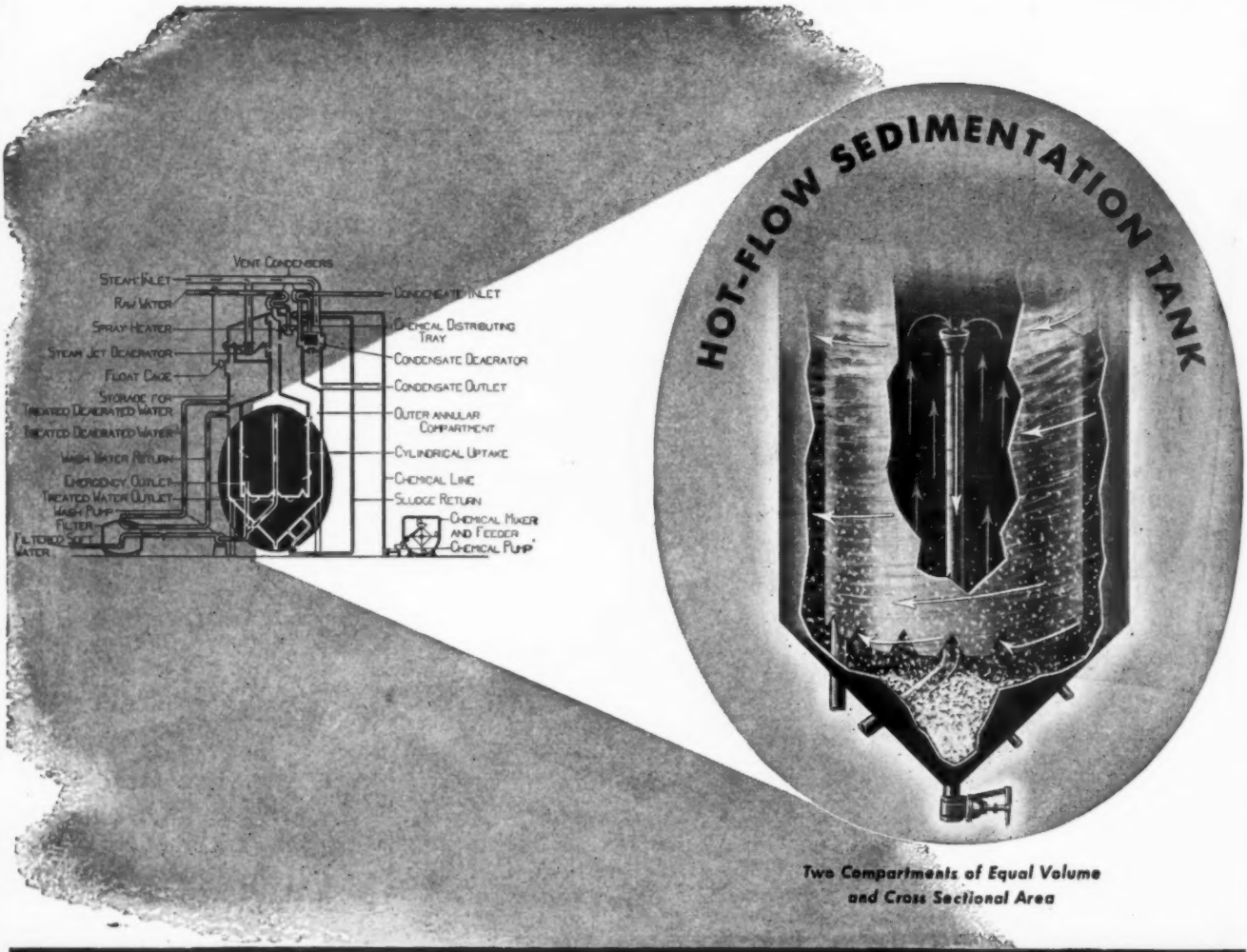

Two Compartments of Equal Volume and Cross Sectional Area

HOT-FLOW SOFTENERS FOR BOILER FEED-WATER TREATMENT . . . .

PLUS VALUE No. 1 SEDIMENTATION TANK DESIGN

EQUAL VOLUMES: The water must spend half its retention time traveling down the outer compartment—so chemical reactions are completed and solids precipitated long before the water turns upward into the inner compartment.

EQUAL CROSS SECTIONS: There is no variation in velocity of forward travel from inlet to outlet—not even at the point of change in direction of flow.

Thus, this design feature establishes an operating condition conducive to maximum solids separation and sedimentation. The result is an ample volume of properly settled, relatively clear water always ahead of the filters, and this

- **permits 350% overload when backwashing**
- **permits full recovery of wash water**
- **increases the length of filter runs**
- **increases the life of filtering media**
- **reduces operating attention required**
- **eliminates the need for any coagulant**
- **assures high clarity of filter effluent**

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INCORPORATED
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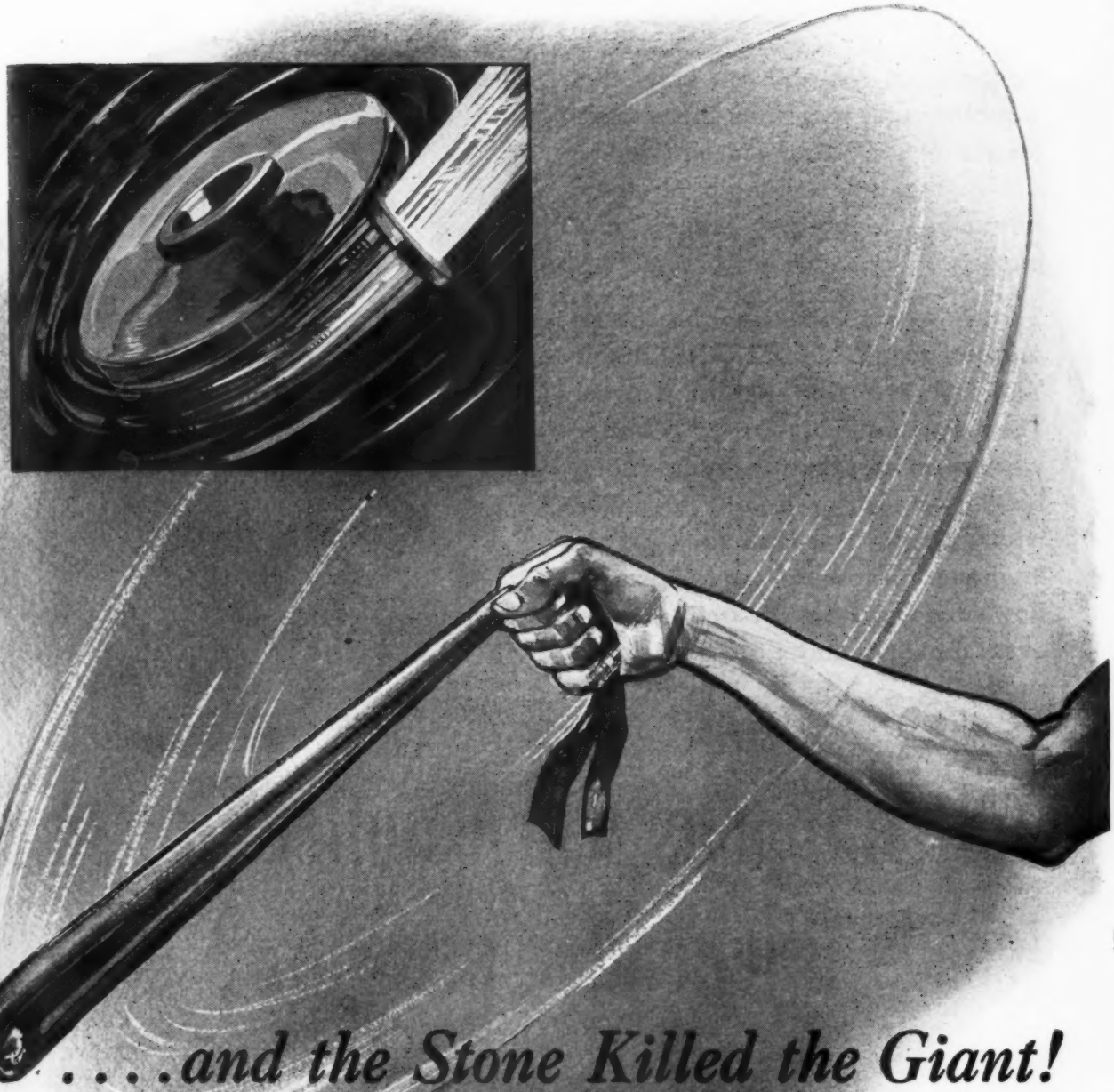

. . . . and the Stone Killed the Giant!

It took a stone flung with tremendous velocity to crack the skull of Goliath—an impetus beyond the power of David's puny, human strength. His conquest was made possible by a harmless-looking slingshot... a primitive weapon which derived its potency from centrifugal force.

This same age-old principle, its effectiveness multiplied by the miracle of modern engineering, is embodied in the centrifugal pump... a highly efficient machine universally used in the transportation of vital liquids. It handles liquids of every type and consistency... oil and gasoline, chemicals, foods, paper stock, water and a myriad of others. It serves the liquid-moving needs of civilization on land, in deep mines, aboard ship and on airplanes. Few other machines bear such a responsibility so capably.

Ingersoll-Rand engineers are pump specialists. Their years of experience in applying centrifugal pumps to industries of every description are at your disposal. Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, New York.

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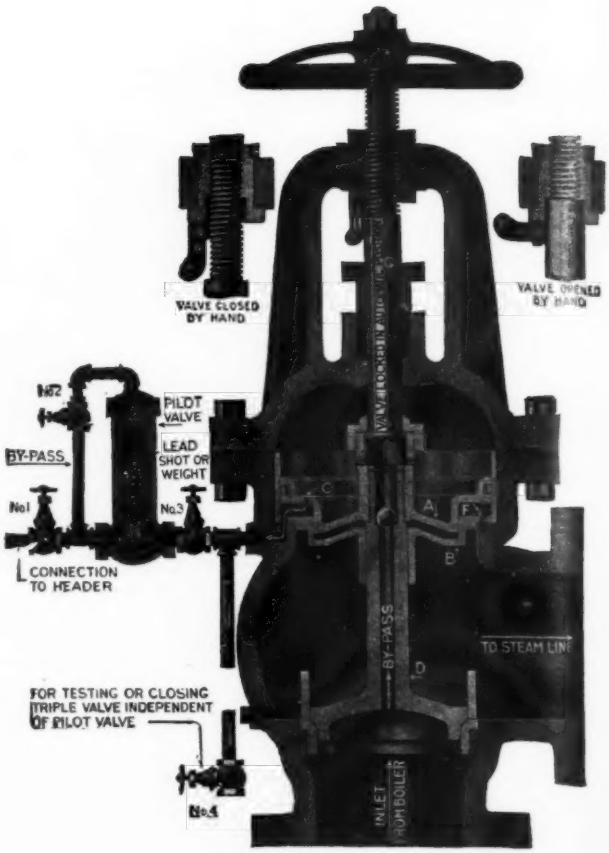
10-487

CENTRIFUGAL PUMPS • CONDENSERS • COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES

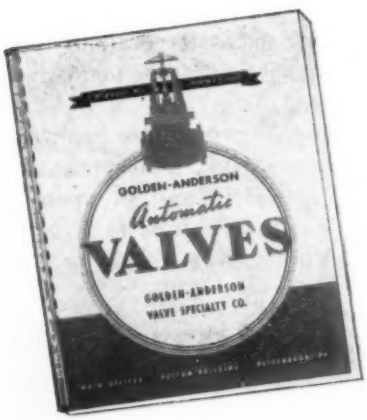
That's easy! We, and you, know that trouble comes fast when this circumstance exists. And it's equally as certain that the resulting burst steam lines mean "down-time", repairs and expense.

That's the problem—now here's the answer. Install GOLDEN-ANDERSON Triple Acting Non Return Valves! They automatically cut in a boiler whenever its pressure equals lineheader pressure—isolate a boiler whenever its pressure falls below lineheader pressure, and stop the flow of steam from the boiler in the event that lineheader pressure drops suddenly.



What happens when boiler pressure exceeds lineheader pressure?

You can get complete details on this valve by writing for a copy of the GOLDEN-ANDERSON Catalog. It describes and illustrates every valve in our complete line of specialty valves.



GOLDEN-ANDERSON
Valve Specialty Co.

Fulton Bldg.
Pittsburgh, Penn.

You'll want all the production capacity possible from new, improved electrical equipment. Then don't let inadequate wiring rob you of equipment performance you pay for. Assure sufficient current for efficient operation of future electrical apparatus.

Remember, wiring won't stretch. Check up on your wiring plans *now!* It's far wiser to change blueprints than risk costly alterations later. This is the time to call in consulting or plant power engineer—electrical contractor or power salesman. They'll advise *foresighted* wiring. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company. General Offices: 25 Broadway, New York City 4. Chicago Office: 20 North Wacker Drive 6. Sales Offices in Principal Cities. 45311

Get the performance you pay for in modern equipment—

Wire ahead

You wouldn't accept equipment that performed only part way—then why let inadequate electrical wiring cut production efficiency?
HELP BRING VICTORY SOONER
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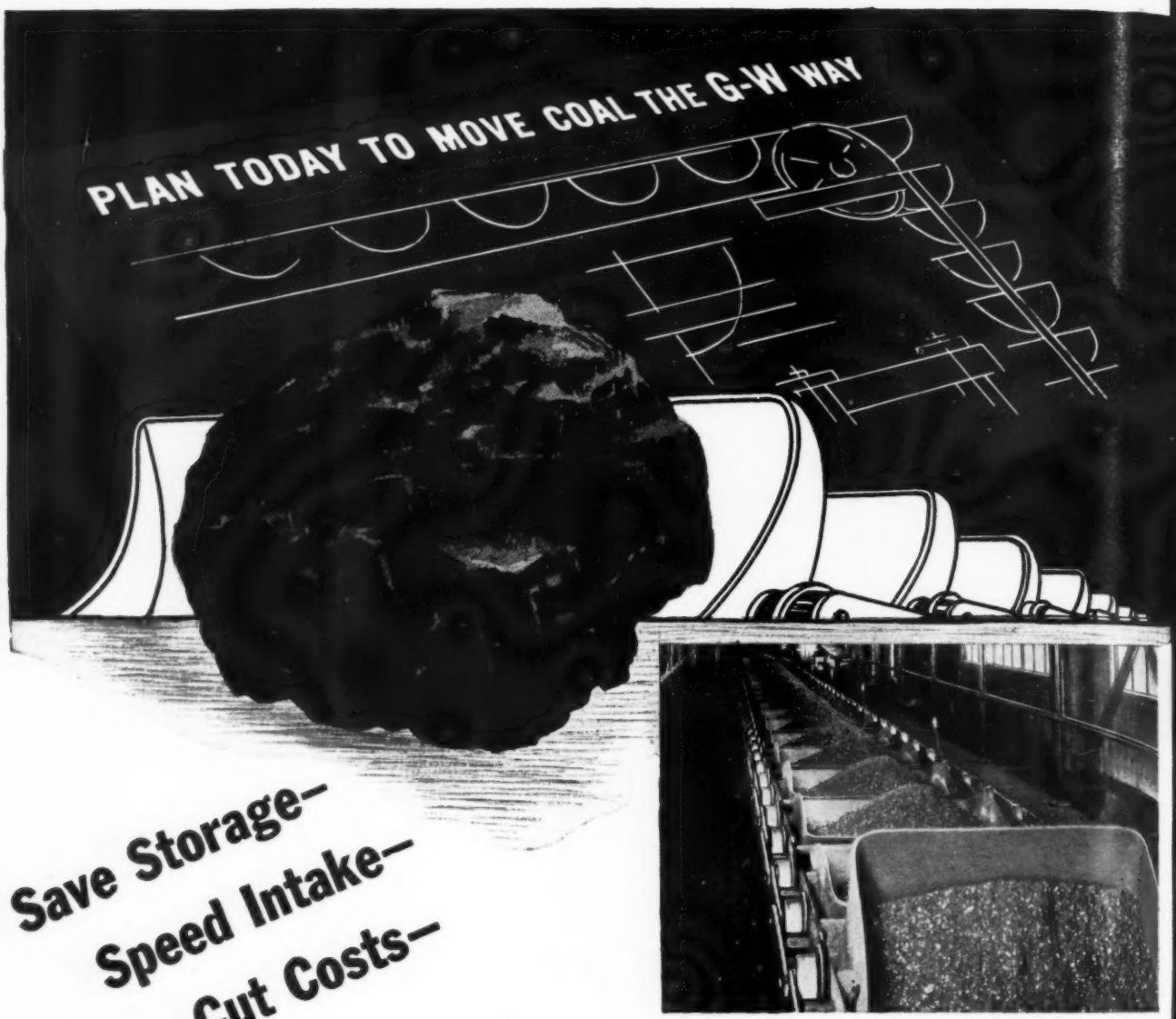
ANACONDA
ANACONDA WIRE & CABLE COMPANY



Save Storage— Speed Intake— Cut Costs—

There is no longer any question as to whether coal should be received, stored and reclaimed mechanically or manually —it has been answered conclusively in many actual instances ... in favor of mechanical handling equipment.

But there *are* three questions that power men face today in their plans to effect boiler room economies by installing the most practical, reliable, durable, coal handling system. They are ... what is the best layout — what type of equipment should be used—what manufacturer offers dependable, efficient equipment and practical engineering help?

Gifford-Wood is qualified to help you answer these questions. Through specialization in the design, construction and installation of coal and ash storage and handling systems for more than 130 years, G-W can give you an unbiased recommendation on the right types of conveyors, carriers, skip hoists, and elevators, and their best arrangement for meeting your requirements.

Although war activities still have first call on manufacturing facilities, Gifford-Wood's long experience in material handling is at the disposal of your engineering department right now for planning. So when you need a system to move coal in — and move ashes out — plan to do it faster, easier and cheaper ..."The G-W Way". Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington St., Chicago 6, Ill. Factory—Hudson, N. Y.

DO YOU KNOW? G-W maintains the complete facilities of a well-organized, manufacturing plant ... pattern shop, machine shop, steel, forge, paint and inspection shops ... fully equipped with modern machinery for handling all general contract work.

G-W HANDLES IT
Faster · Easier · Cheaper

GIFFORD-WOOD

SINCE 1814

"...now use Ring-Free exclusively..."

Excerpts from letter of—
N. G. HILL
N. G. Hill & Co., Contractors
Phoenix, Arizona

"...four years ago, after we purchased a fleet of Chevrolet trucks for a road construction job on Highway 77, we were induced to try Ring-Free Motor Oil.

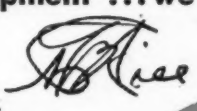
...the test was a tough one due to weather conditions...heavy snow and rain in winter...heat and dust storms in summer.

...during all this time we did not pull a head or pan in any of the trucks except one damaged by striking a huge boulder.

...after the job was completed we removed heads and pans on all motors which had from 50,000 to 60,000 motor miles.

...all compression rings were free...all drain holes in oil rings open...also drain back holes in pistons completely open and no carbon on the under side of the pistons. Cylinder heads and valves were also clean and all valve stems free in the guides. Engine pans and oil pump screens were cleaner than we expected...all bearings were in good shape.

...we now use Ring-Free exclusively in all our equipment*...we recommend Ring-Free Motor Oil to other contractors."



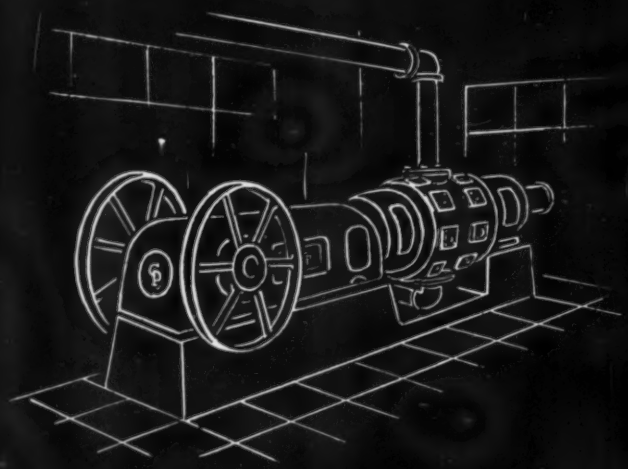
** 36 Trucks—Fords, Chevrolets, Internationals; 6 A.C. Tractors, Diesel powered. 1 D-8 Caterpillar; 3 Graders—2 powered by International and 1 by Caterpillar motor; 1 International T. D-40 Tractor; 1 Lorraine 40—¾ cubic yard power shovel; 3 Light Plants powered by Kohler motors; 1 Gravel plant powered by 8800 Caterpillar Diesel. Also numerous pick-ups and station wagons.*

Operators of all types of equipment report lower-cost, more efficient performance with Ring-Free Motor Oil. Find out how Ring-Free can help lick your toughest lubrication problems... Phone or write the nearest Macmillan office.

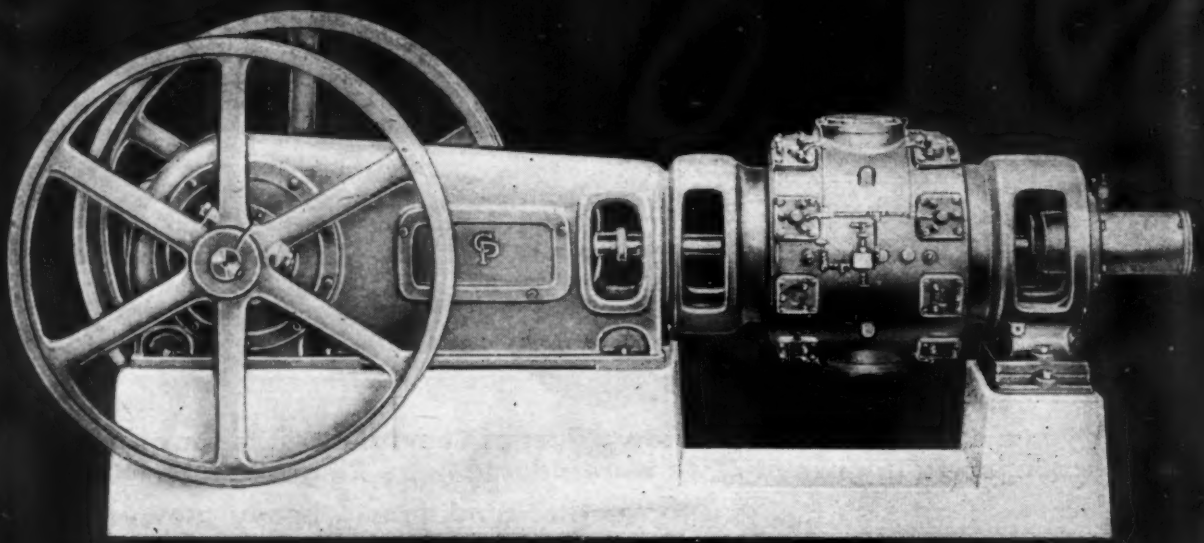
MACMILLAN RING-FREE MOTOR OIL

MACMILLAN PETROLEUM CORPORATION

W. 50th Street, New York 20 • 624 So. Michigan Avenue, Chicago 5 • 530 W. Sixth Street, Los Angeles 14 • Copyright 1945, Macmillan Petroleum Corporation



No Oil to Cause Spoilage



CP Oil-less Cylinder Compressors have been developed for use where the air or gas compressed must be free from oil. No oil, grease or other cylinder lubricant is required. Piston and rod, completely supported by crossheads, are full floating, removing all weight from cylinder walls and stuffing boxes, thereby avoiding wear of carbon piston rings and hardened steel cylinder liner. Trouble-free operation and long life of wearing parts are assured. Only normal maintenance is required — no need for periodic rotation of piston rings.

CP Oil-less Cylinder Compressors are arranged for belt, motor or steam drive, in single stage and two-stage types. They are available in a wide range of sizes and ratings. Write for complete information.

★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
HYDRAULIC TOOLS
ROCK DRILLS

CHICAGO PNEUMATIC
TOOL CP COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

Dutton ECONOTHERM
AUTOMATIC STEAM GENERATOR

... as complete as that!

Ready to set down in your boiler room and run! The Dutton Econotherm is a completely self contained "plug in" job with all controls wired and all piping complete — the only installation costs are connecting fuel, water and steam lines; a saving of at least 20%. The ultimate in automatic "packaged" steam generation — backed by our 65 years experience.

Ingenious Dutton controls automatically regulate every function of the generator, constantly making adjustments to insure efficient, clean and economical operation. Supervision and maintenance costs are almost negligible.

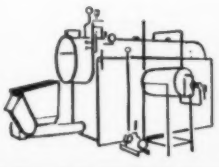
The exclusive Dutton design of rotary combustion, three pass heating and induced draft system give unexcelled performance through increased firing rate, quicker steaming, uniform circulation and meets maximum steam demands without variation in pressure or changes in water level. All gases scavenged — no chimney necessary other than small pipe to carry flue gases through roof.

Either gas or oil fired — 80% efficiency guaranteed. All capacities up to 150 H.P.

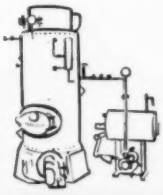
Our engineers will be glad to analyze your requirements and make sound recommendations.

WRITE FOR FULL DETAILS

DUTTON ECONOMIST HIGH PRESSURE BOILERS



Dutton



DUTTON AUTOMATIC VERTICAL BOILERS

PRESSURE VESSELS • HEAT EXCHANGERS • CONDENSERS

THE C. H. DUTTON COMPANY • 622 GIBSON STREET • KALAMAZOO, MICHIGAN

STAMINA*

. . . . you find more of it in Marsh Gauges

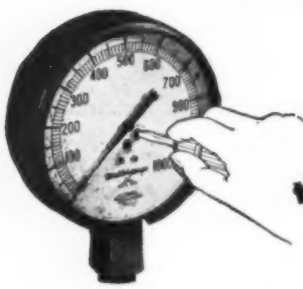
OF course a pressure gauge should be responsive to the most delicate changes in pressure. That is easy enough to accomplish in an instrument built along delicate lines, and such a gauge may be all right in a physics laboratory.

But the industrial application is a horse of another color. The gauge out on the job may be hit with a surge of over-pressure. Or Joe Doak may sock it with a piece of pipe he is carrying. Or anything else may happen. So the industrial gauge must be both as sensitive as a cat's whisker, and as sturdy as an ox.

That's the hard combination of qualities to achieve, and the remarkable degree with which it is achieved in Marsh Gauges distinguishes them from all others. Every part and element of Marsh Gauges is designed and built with an eye on stamina and the lasting accuracy it assures . . . the better bourdon tubes . . . the precise but rugged movement protected from external shocks by the Marsh "unit construction" . . . the sturdier gearing and linkage . . . many other refinements.

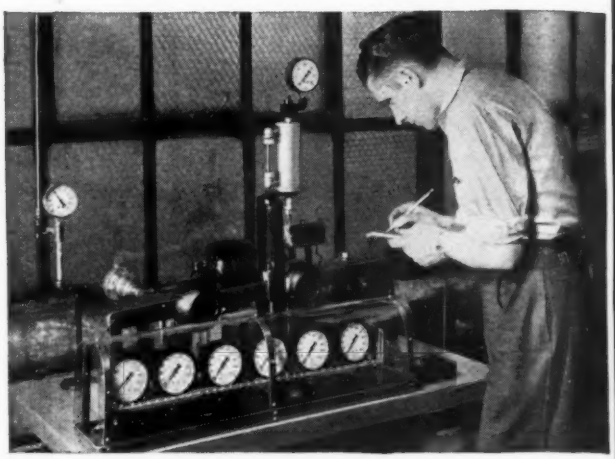
Tests like those shown here are at the top of our precaution list. We make Marsh Gauges to stand up, and we constantly prove their ability to do just that by pulsation and vibration tests. Make no mistake about it: The stamina of Marsh Gauges is truly an unduplicated feature!

JAS. P. MARSH CORPORATION
2075 SOUTHPORT AVE., CHICAGO 14, ILLINOIS
Export Department: 155 E. 44th St., New York 17, N. Y.

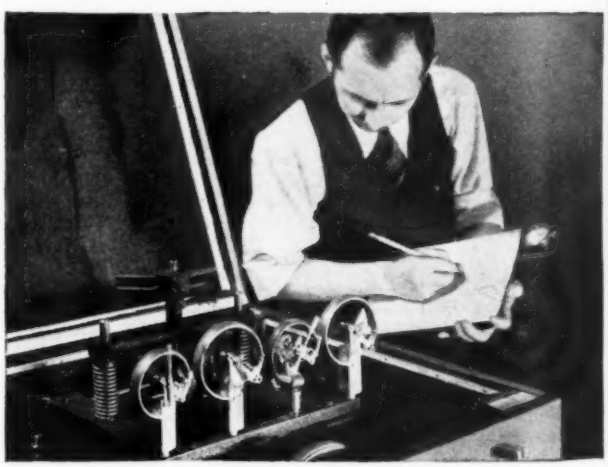


the gauge with the "RECALIBRATOR"

■ We not only built them to stay accurate, we also give you the easiest, quickest and best way to restore accuracy when extreme shock knocks them out of adjustment.



This pulsation test won't take "no" for an answer. It searches out bourdon tube and other weaknesses . . . has fathered many improvements in materials, manufacturing methods and design.



Brutal vibration is what gauges are subjected to in this test. Representative gauges from each production group are here given a far rougher shaking up than they would receive in any conceivable field application.

MARSH GAUGES

DIAL THERMOMETERS
HEATING SPECIALTIES

*One of a series of advertisements high-lighting the factors that make Marsh instruments "THE STANDARD OF ACCURACY"

New Solutions

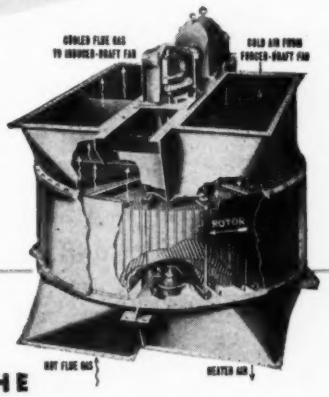
to Heat Recovery Problems may begin with

PREHEAT ENGINEERING

If heat recovery is important to your process, it's possible that some standard or special application of preheat engineering may lead to new operating economies. Here are four specific reasons why you should call in the preheat engineer when plans for new plants, or modernization of old ones, are under consideration.

1. You can design furnaces to take advantage of the benefits of higher heat recovery.
2. Recent new preheater uses, including application to a reverberatory copper-smelter furnace and special applications in sewage treatment plants may indicate how you can increase the efficiency of your production processes.
3. You can take advantage of the added efficiency which generally results from designing a plant specifically for use with the Ljungstrom Air Preheater.
4. The air preheater engineers can help you solve problems arising from corrosion or deposit formation on the heat exchange surface.

So, while your plans for the future are still on the drafting tables, why not check with our engineers?



THE

LJUNGSTROM

AIR PREHEATER

The continuous, regenerative, counterflow principle of the Ljungstrom Air Preheater provides a maximum heat transfer with minimum weight and size. The rotating, cylindrical heat-transfer surface "soaks up" heat in the hot gas chamber, then rotates into the chamber where it gives up this heat to the entering air.

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

Which will it be in a highly competitive tomorrow?

?

EFFICIENT business never has money to burn — a fact that will prove doubly important tomorrow when every expenditure will count heavily in a keenly competitive market.

Yet, while your boiler plant equipment remains outmoded, you may be tossing $10 (or more) out of every $100 paid out for the production of steam, right into the fire. You're simply not securing *full* use of your oil or gas.

That's where Todd Automatic Burners for liquid or gaseous combustion mean the *profitable* difference between high and low-cost steam.

Regardless of the type specified, Todd oil or gas burners actually shave steam production costs up to 10% or better. At the same time, they step up power capacity to maximum and cut maintenance charges to the bone.

For *cheaper* production of power and heat, for industrial or commercial use, you're *combustion-wise* when you *modernize* with *Todd*. Our engineers are at your ready disposal for consultation on your specifications.

NAVY
COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
601 West 26th Street, New York 1, N. Y.
NEW YORK, BROOKLYN, ROCHESTER, HOBOKEN, NEWARK, BARBER, N. J., PHILADELPHIA, SO. PORTLAND, ME., BOSTON, SPRINGFIELD, MASS., BALTIMORE, WASHINGTON, CHICAGO, GRAND RAPIDS, TAMPA, GALVESTON, HOUSTON, MOBILE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, SEATTLE, TACOMA, MONTREAL, TORONTO, BUENOS AIRES, LONDON
TODD
NEW YORK, U.S.A.

ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

NATIONAL ELECTRIC PRODUCTS

WIRING SYSTEMS

WIRES AND CABLES

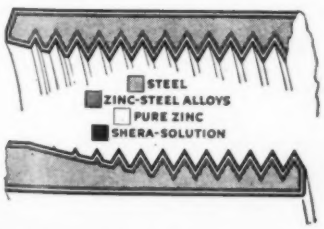
Sherarduct

A RIGID STEEL CONDUIT

worthy of your finest buildings

NATIONAL ELECTRIC SHERARDUCT

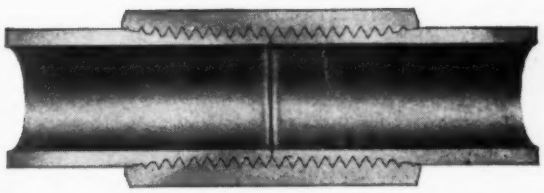
- IS MORE HIGHLY RESISTANT TO MOISTURE AND CORROSIVES.
- BENDS MORE READILY.
- FABRICATES INTO THE JOB EASIER.
- "LASTS AS LONG AS THE JOB."



Cross-section of Sherarduct

NE Sherarduct is a rigid steel electrical conduit that is worthy of the finest buildings. National Electric pioneered "Sherardizing" over thirty years ago. This process, by which zinc dust is driven into steel pipe and applied to the surface under heat, is unsurpassed for protection against rust and corrosion.

Even deposit of the zinc gives a uniformly protected, smooth surface over which is applied Shera-solution which impregnates the zinc. In addition, the steel is "Spellerized" to produce a pipe which works more smoothly, bends easier and threads cleaner.



The craftsmanship in this conduit is illustrated by the coupling. The tapered threads provide strong, close union which keeps out corrosion. For complete information write for our 350 Page Engineering Data Book—free.

INSULATION "FALLING DOWN" ON THE JOB?

SIMPLY APPLY UNIBESTOS

it's simple to apply!

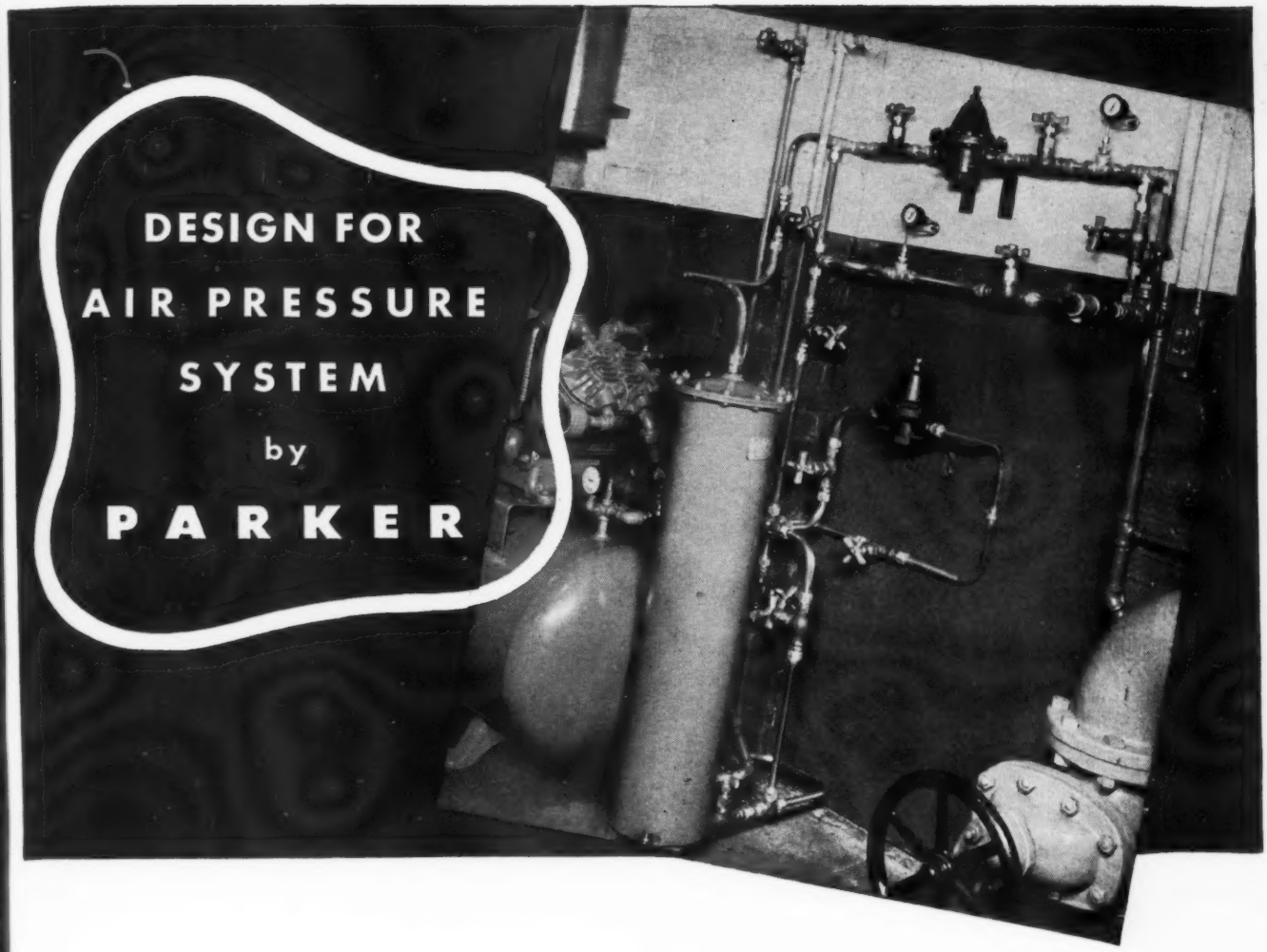
Here's an insulation that won't "fall down" on the job! Unibestos will not sag, gap, shatter or shakedown under the most severe vibration—always remains snug and firm against pipe, thus assuring maximum protection with a minimum of heat loss. Moreover, Unibestos efficiency is unaffected by moisture. Even when soaked, moisture can be steamed off without damaging Unibestos structural strength.

Unibestos is available in half-section form up to 30" pipe diameter, and in quarter-section form from 32" to 60"—in thicknesses from ¾" to 5". Single layer construction is available for service up to 1200°.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

COPYRIGHT 1944
UNION ASBESTOS AND RUBBER CO.

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • CICERO, ILL. • NEW YORK • SAN FRANCISCO • PATERSON, N. J.



Let's take a frank look at the things that make the controls work—on this air pressure system or on *your* machines.

Here are the specifications for the kind of tubing system that sound Fluid Power Engineering calls for:

Streamlined Flow—for minimum pressure drop, freedom from obstructions and minimum demand on power source.

Space Saving—making best possible use of available space.

Easy Accessibility—for quick and inexpensive service and maintenance.

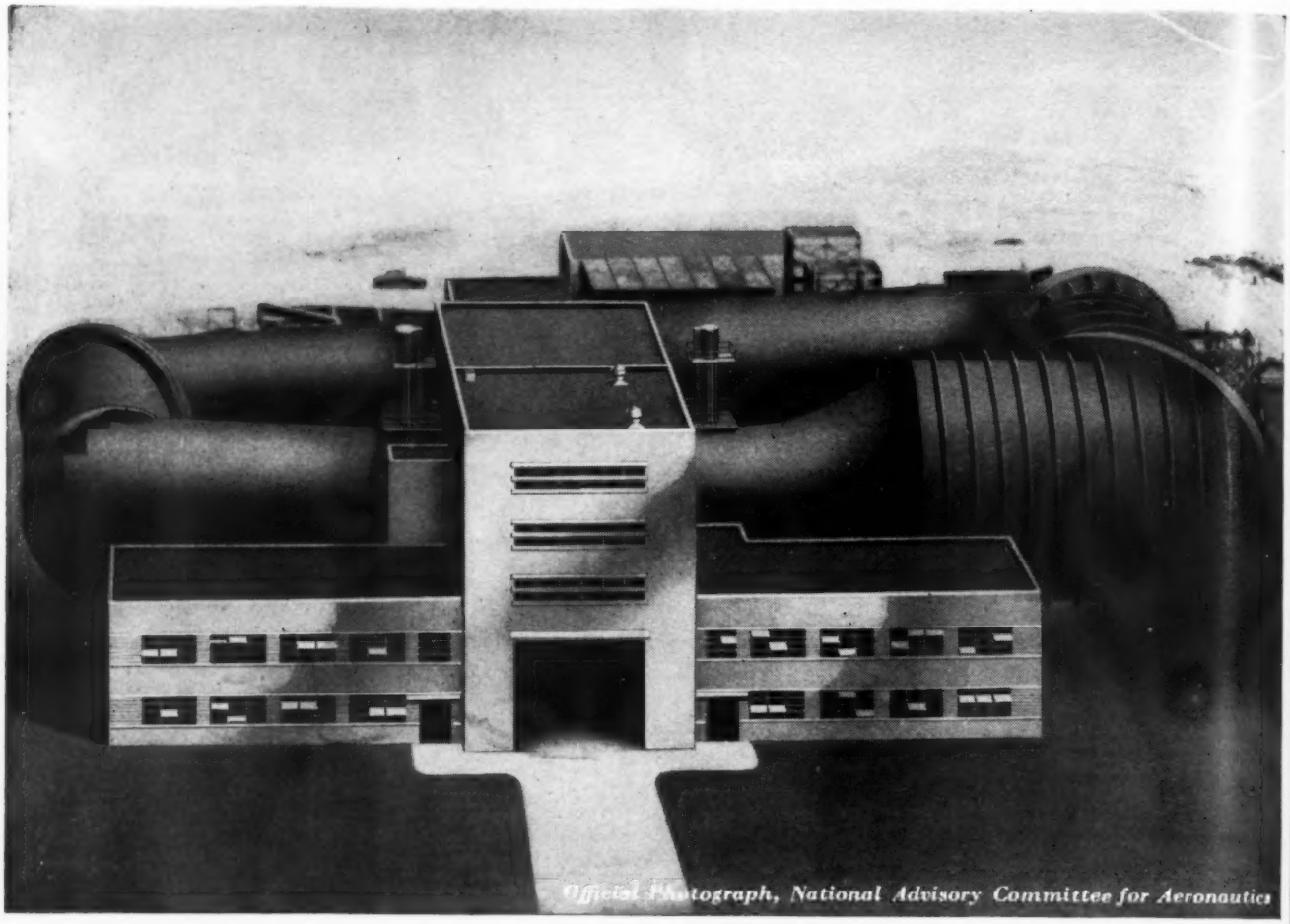
Fewer Joints and Connections—for greater protection against the possibility of leaks, even under conditions of severe vibration, high pressures and abuse.

Parker Fluid Power engineers, for more than twenty years, have been designing these systems — for aircraft, motor vehicles, machine tools, refrigeration and process equipment.

We've been building the valves and fittings and the fabricated tubing, for Fluid Power installations, and for fluid transmission.

Whatever you make or plan to make, this broad experience is yours to command. Consult with a Parker engineer, especially in the planning stage. For this service, or for more information, write to The Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

PARKER



YOLOY AIDS JET PROPULSION RESEARCH IN FRIGID STRATOSPHERE HURRICANES

YOLOY steel forms the walls of a new sub-zero high-altitude wind tunnel at the engine research laboratory of the National Advisory Committee for Aeronautics, at Cleveland, Ohio. This is the only wind tunnel of its type in the world. Yoloy was selected for this job because of its high resistance to impact and its freedom from brittleness at very low temperatures.

This wind tunnel is already in use in advanced studies of jet propulsion engines and other critical development projects. In the tunnel, an 18,000 hp motor driving a 32½-foot fan generates a 500 m.p.h wind at a temperature of 48° below zero. The tunnel also duplicates the low pressures of high altitudes.

Yoloy is a high tensile, low carbon nickel-copper alloy steel. It is highly resistant to corrosion, is easy to machine and form and weld, and its unusual strength makes it ideal for structures and products where weight saving is important. Yoloy is available in plates, sheets, strip, shapes, wire, seamless and electric weld pipe.

This Yoloy-lined N.A.C.A. wind tunnel, only one of its kind in the world, produces the extremely low temperatures and pressures of the substratosphere, for testing and improving aircraft and engine performance.

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

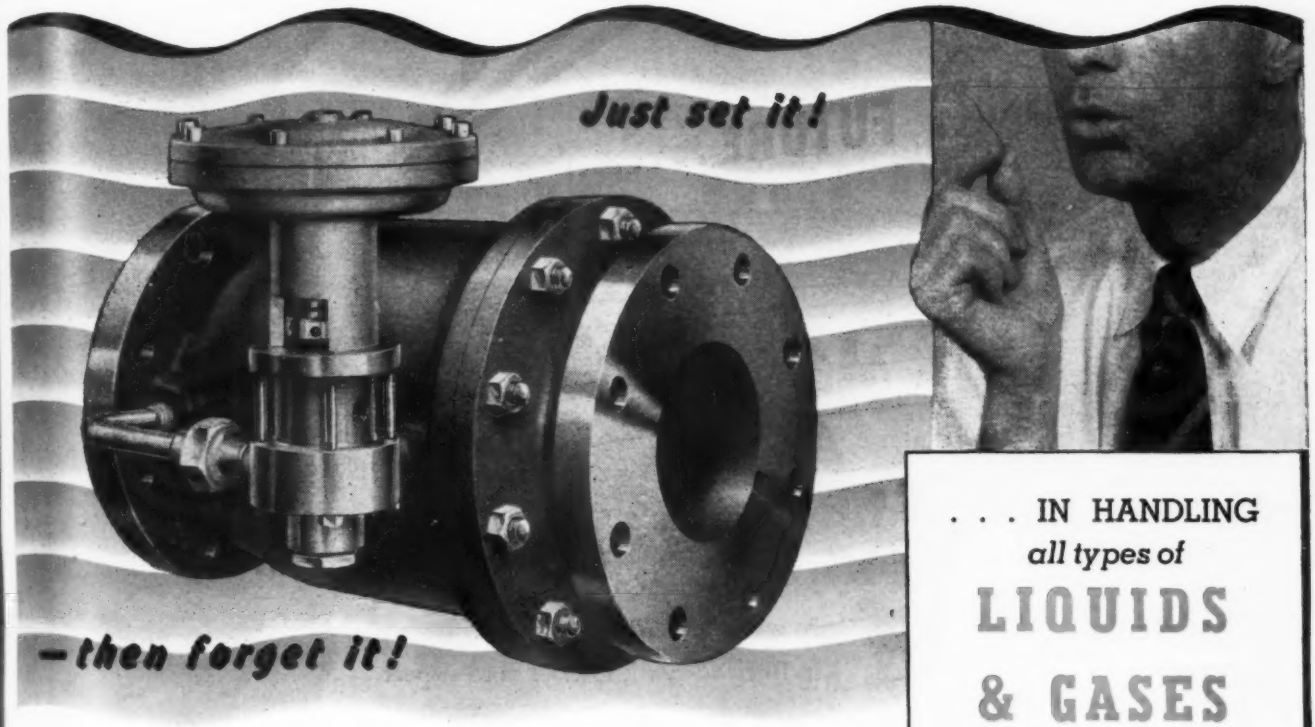
Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Electrolytic Tin Plate - Coke Tin Plate - Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels.

Instantly Responsive Back Pressure or Relief

...as Sensitive as a Human Hair to a Breath of Air

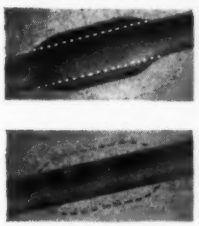


. . . IN HANDLING
all types of
LIQUIDS & GASES
Including: HIGHLY Volatile and Reactive Fluids

Insures POSITIVE *Bubble-Tight* Shut-off

As it requires only a slight increase in line pressure to operate the Grove Flexflo fully self-contained Back Pressure Regulator or Relief Valve, it is possible to set it for instantaneous "hair-trigger" response. There is absolutely no chance for "hang-up" or sticking to occur. Flexive expansible tube insures smoother, quieter operation with positive bubble-tight shut-off and dependable leak-proof service in controlling all types of liquids and gases. It is entirely unaffected by suspended solids in the flowing stream and automatically self-compensates for any erosion or wear. No packing glands or stuffing boxes are employed, which eliminates leakage losses, hazards and failure. Sizes range from 1½" to 12" for standard pressures—also designed for pressures from 200 to 2500 lbs.

HYDRAULICALLY AND PNEUMATICALLY SELF-OPERATING



EXPANDS TO OPEN

CONTRACTS TO CLOSE

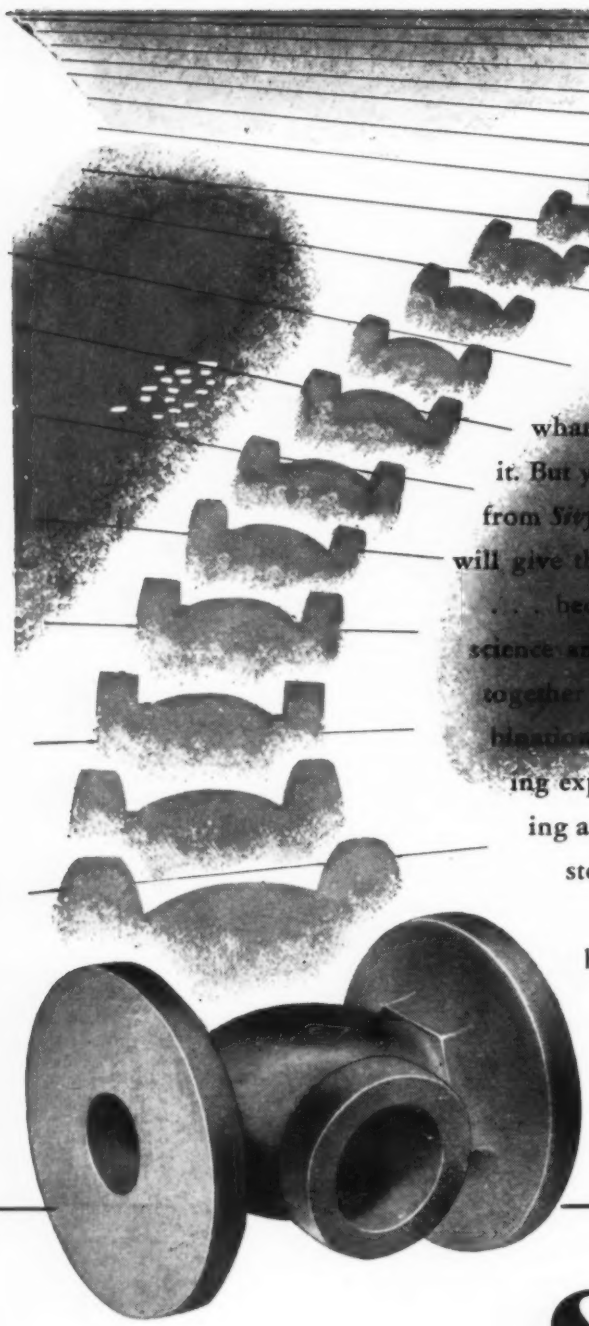
GROVE *Automatic... Self-Operating* FLEX-FLO

BACK PRESSURE REGULATOR—OR RELIEF VALVE

GROVE REGULATOR COMPANY

6547 GREEN STREET, OAKLAND 8, CALIFORNIA • *Branch Offices:* 30 Rockefeller Plaza, New York 20 • 5644 Navigation Boulevard, Houston 11, Texas • 1930 West Olympic Boulevard, Los Angeles 6, California

ITS PERFECT PAST ASSURES ITS LONG FUTURE.....



● You can't measure or see what's in a casting by looking at it. But you *can* know what to expect from *Sivyer* castings—know that they will give the kind of service you want . . . . because, in every known way, science and human skill have worked together to this end. It is this combination of Sivyer's 36 years of casting experience and laboratory testing and control that assures *sound* steel castings for *better* service —and is the reason critical buyers specify castings carrying the Sivyer diamond ◈—the mark worth looking for.

ARMY E NAVY

SIVYER STEEL CASTING COMPANY

MILWAUKEE S CHICAGO S

ROTO TUBE CLEANERS

for

IMMEDIATE DELIVERY from Stock

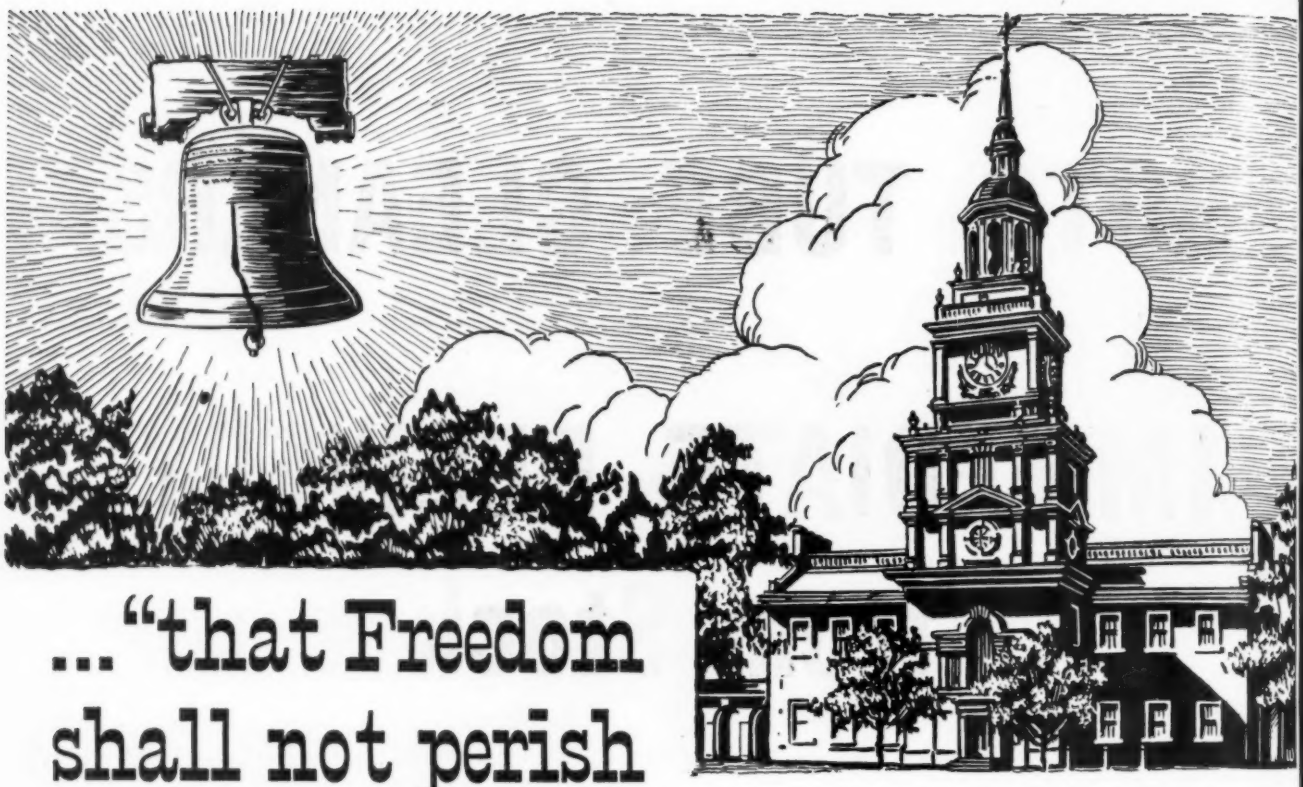
Here is good news for all who need tube cleaners. We are now able to ship normal requirements for tube cleaning equipment directly from stock, despite a record demand for Roto Tube Cleaners by war plants, the armed forces, and Allied merchant navies.

Greatly enlarged and improved production facilities enable us to make immediate deliveries, regardless of priorities.

Write, wire or phone your nearest Roto representative, or contact us directly.

ROTO DIVISION of ELLIOTT COMPANY

145 Sussex Avenue, Newark 1, N. J.



..."that Freedom shall not perish from the earth."

IN PHILADELPHIA on the Fourth of July 1776, there was signed an historic document, conceding government by the consent of the governed... liberty and independence to the individual . . . and establishing a society in which all men are free and equal.

The bell which rang out from the tower of the old State House to mark the signing of the Declaration of Independence... "proclaimed liberty throughout the world". Here were laid the foundations for a great Nation of freedom loving people.

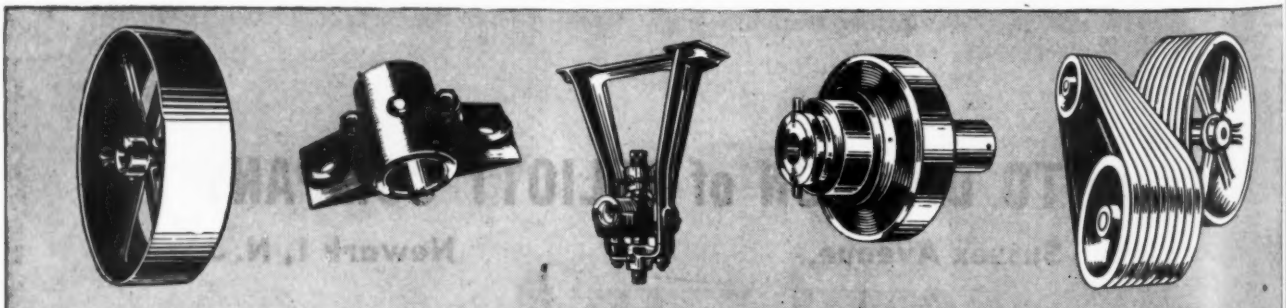
Here was kindled the torch which today lights the way to *world* freedom. Here were born the ideals which even now are prompting brave men to lay down their lives in defense of the Four Freedoms... may their sacrifice not be in vain.

Just eighty-one years after the signing of the Declaration, T. B. Wood's Sons started in business. Some of the children of the younger listeners upon whose ears fell the joyful peal of the Liberty bell, were among the first users of Wood's products.

Today, Wood's planned power transmission for direct drives, modern group drives or V-Belt drives are serving industry dependably and efficiently. Write us, or see your local Wood's dealer for detailed information . . . no obligation.

EVERYTHING IN TRANSMISSION

Bearings — Collars — Clutches — Couplings — Contactors — Hangers — Pillow Blocks — Pulleys — V-Belt Sheaves and Complete Drives



T. B. WOOD'S SONS COMPANY, CHAMBERSBURG, PENNA.

BRANCHES: BOSTON, MASS. • NEWARK, N. J. • PITTSBURGH, PA. • CLEVELAND, OHIO • DETROIT, MICH. • HOUSTON, TEXAS

In the last Analysis

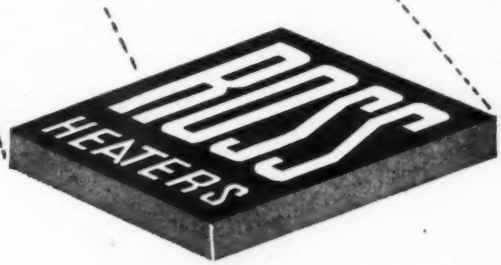
...sturdiness, operating efficiency and economy are your foremost interests in heating equipment. There you have the basic principles determining the design and construction of Ross Heaters.

Simple design and sturdy construction of durable materials...Highest heat transfer with lowest pressure loss through arrangement of baffling...Permanent tube joints roller expanded...No internal gaskets to leak...Tubes accessible for easy inspection and quick cleaning...Conservative capacity ratings to assure constant, trouble-free service ...Easily installed through provisions for mounting in any position and to meet any piping layout.

Ross has a real story to tell on heating equipment. Either of these two bulletins will sum it up for you quickly. Then, have a Ross heat exchange engineer go over your individual problems with you.

BULLETIN 3624-A: Straight Tube Heaters and Preheaters for fuel oils and other heavy fluids. Tank Suction Heaters for heavy viscous fluids.

BULLETIN 3623-A: Closed Type Feed Water Heaters. Service Water Heaters. Hot Water Converters. Process Heaters.



ROSS HEATER & MFG. CO., Inc.

Division of American Radiator & Standard Sanitary Corporation

1415 WEST AVE, BUFFALO 13, N. Y.

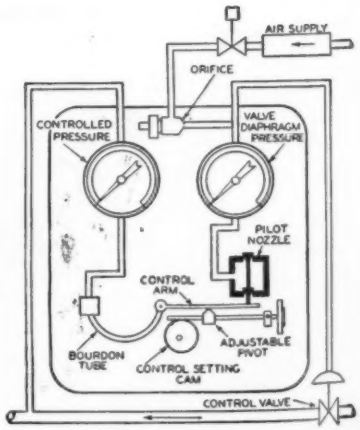
FOR LOW COST INSTRUMENT CONTROL

Use Masoneilan Pressure Controllers

Want accurate instrument control of pressures in processes where other less efficient methods are now used? Then install Masoneilan No. 2500 Pressure Controllers.

These simple, accurate and economical controllers are especially designed to give *low cost* instrument control of a wide variety of applications such as service on primary or auxiliary steam lines, evaporators, turbine or bleeder make-up and pump discharge pressure control. Note these features — external knob for adjusting micrometer control point setting, throttling range from 3 to 50%, easily convertible, from direct to reverse acting or vice versa.

Why put up with less efficient methods when you can get *low cost* accurate instrument control with Masoneilan No. 2500 Pressure Controllers. Write for bulletin, today.



MASONEILAN

MASON-NEILAN REGULATOR COMPANY

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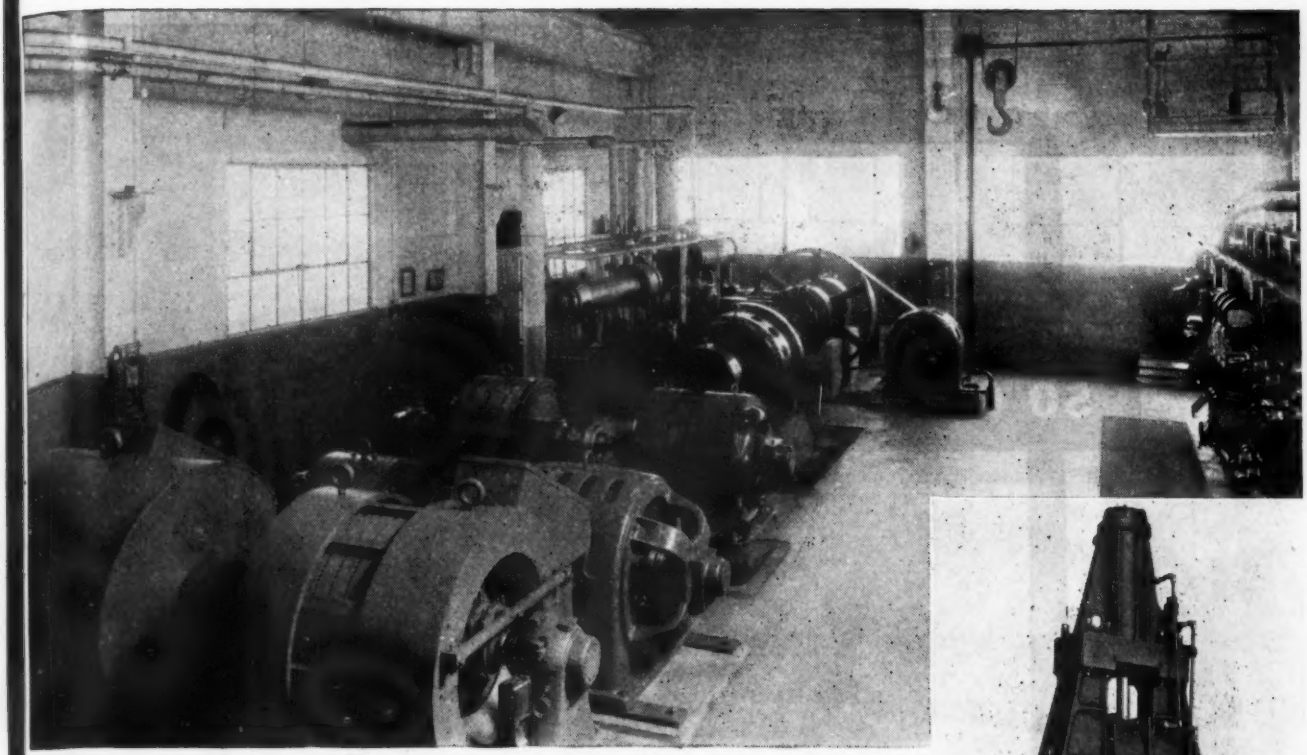
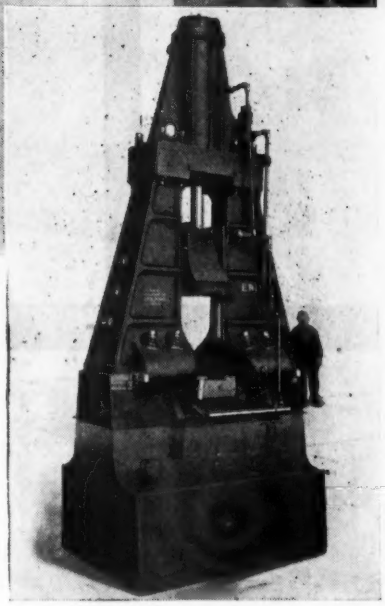
New York, Philadelphia, Pittsburgh, Cleveland, Chicago, Tulsa, Atlanta, St. Louis, Houston, Los Angeles, San Francisco. Mason Regulator Co. of Canada, Ltd., Montreal, Can





IN THE PLANT OF THE WORLD'S LARGEST BUILDER OF STEAM HAMMERS

BURKE has a *40 Year Record*

ILLUSTRATED ABOVE are shown front to rear the following BURKE UNITS in the plant of the Erie Foundry Company.

For D C Power Requirements:
1—400 K. W. Synchronous M-G Set.
1—200 K. W. " " "
1—150 K. W. " " "

For Driving Air Compressors:
1—100 H. P. Synchronous MOTOR (Direct Drive)
1— 60 H. P. Induction MOTOR (Belt Drive)

For over 40 years, the Erie Foundry Co., world's largest builder of steam hammers, has indicated its approval of Burke Motors and Generators by their long continued use in the power plant pictured above.

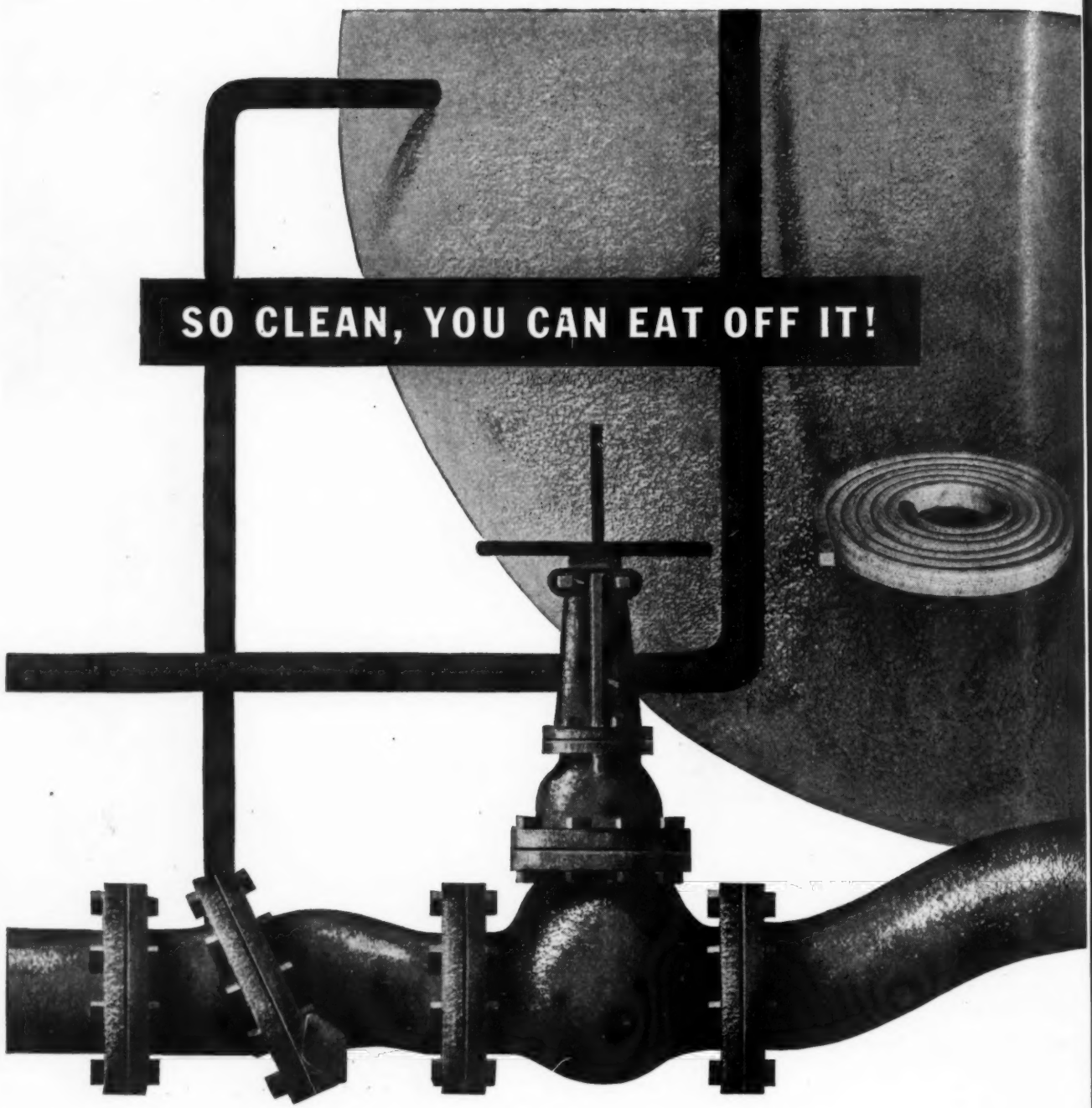
For 54 years, Burke has built motors and generators to the specific requirements of industry. This long record of designing for the job, rather than to a compromise standard, has given us a flexibility that continues to prove valuable, wherever *a better than standard* electrical unit is desired.

Burke engineers can assist you in the selection of Burke Motors and Generators that will provide continuous, dependable service. *Write Burke Electric Co., 257 W. 12th St., Erie, Pa.*

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

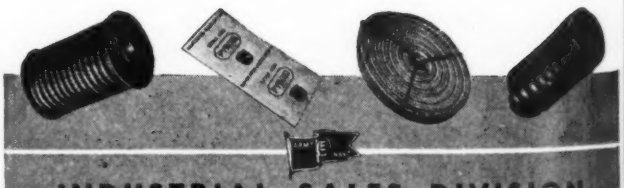


Each of the 73 different kinds of R/M packing is designed to meet a particular problem. In the food industry, for instance, R/M packings meet special sanitary requirements. They're so clean, you can eat off them.

So, whatever your particular packing problem . . . high-pressure steam . . . extreme temperature . . . acids or other chemicals . . . petroleum products . . . there are R/M products to give long and satisfactory performance.

Ask for R/M, the packing backed by more than forty years of experience.

It's "Packed with Satisfaction"—When You Use R/M



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An Announcement
Regarding

CYCLOTHERM STEAM GENERATORS

Cyclotherm Corporation announces its appointment as of June 1, 1945, as the exclusive manufacturer of Cyclotherm units.

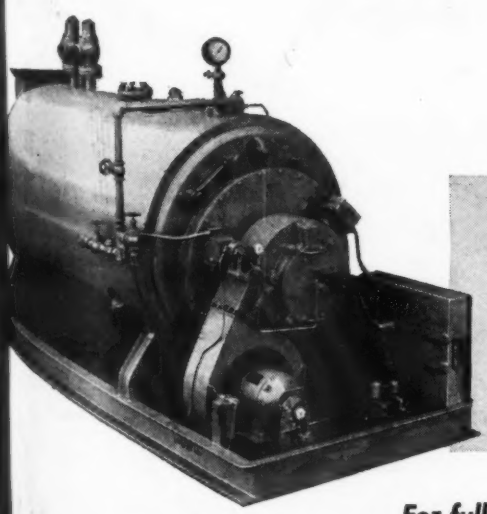
Cyclotherm units alone embody Cyclotherm's unique and patented principles:

- CYCLOTHERM Steam Generators, in sizes ranging from 10 HP to 200 HP, with operating pressures from 15 psi to 200 psi.
- CYCLOTHERM Hot Water Generators.

All units are fully automatic, self-contained, oil or gas fired. Units with combination burners, firing either oil or gas, are also available.

Among Cyclotherm units, manufactured under the designs and patents of General Furnaces Corporation, thousands are in service in vessels of the Navy and Maritime Commission—at Advance Naval Bases—in Army Hospitals and Advance Dressing Stations—in stationary and mobile laundries of the Army, Navy and Marine Corps.

Other Cyclotherms are efficiently and economically furnishing steam to industry throughout the United States and in other countries.



CYCLOTHERM STEAM GENERATOR

For full information and prices write

CYCLOTHERM CORPORATION • 90 BROAD STREET, NEW YORK 4, N. Y.

You can be Sure of Uniformity and Quality when you Specify Globe !

Extra care in production control assures uniformity and quality in all classes of Globe steel tubes. Unvarying quality is safeguarded and production methods and materials exactly controlled by one of the largest and complete chemical and physical laboratories of its kind, concentrating on tubing characteristics and problems.

You can be sure of uniformity and quality when you specify Globe tubes — pressure, mechanical, or stainless.

GLOBE STEEL TUBES CO., Milwaukee 4, Wis., U.S.A.

GLOBE STEEL TUBES

5019

GLOBE TUBES

- ★ Pressure Tubes
- ★ Condenser & Heat Exchanger Tubes
- ★ Seamless Stainless Steel Tubes
- ★ Mechanical Tubing
- ★ Gloweld Welded Stainless Steel Tubes
- ★ Globeiron High Purity Iron Seamless Tubes

PIPE PLUG FOR UNUSED INLET
SIDE INLET FOR STRAIGHT-IN-LINE CONNECTION
BODY SEPARATES HERE FOR EASY ACCESSIBILITY
BUCKET LEVER FASTENS OFF CENTER FOR GREATER POWER
INCOMING CONDENSATE REVERSES FLOW HERE WITH SCRUBBING ACTION
OPTIONAL TOP INLET FOR ELBOW CONNECTION
SIDE INLET
EASY-TO-REMOVE VALVE AND SEAT
BUCKET GUIDED BY CENTER TUBE
BUCKET STOP
BLOW-DOWN OR DRAIN PLUG
A WELL BUILT LONG LASTING TRAP IS ALWAYS MORE ECONOMICAL

Chalk Talk No. 4

ON POSTWAR STEAM TRAP ECONOMY

In previous Chalk Talks, we told you about the economy of simplified piping, the low first-cost for installation, and the savings in inspection of Anderson Super-Silvertop Steam Traps . . . Now we want to point out the economies in the construction features of Super-Silvertop Steam Traps as shown in the above diagram.

Super-Silvertops are exceedingly strong. Their castings are of nickel semi-steel, the bucket and guide tube of copper and bronze, with all working parts of stainless steel. There are no pins to wear out and all working parts ride on knife edge contact, which eliminates practically all friction. And finally there are no restricting passages to become clogged with scale. These construction features of Super-Silvertops make for years of economical service.

THE V. D. ANDERSON CO.
1934 W. 96th Street • Cleveland 2, Ohio

Super-Silvertop
STEAM TRAPS

An Ajax Spiral Wound Gasket For Every Marine and Stationary Application

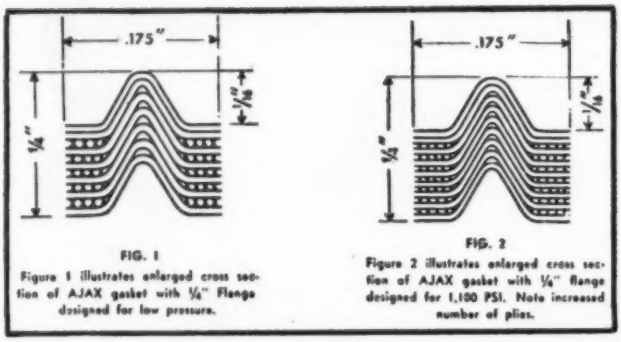


FIG. 1
Figure 1 illustrates enlarged cross section of AJAX gasket with ¼" Flange designed for low pressure.

FIG. 2
Figure 2 illustrates enlarged cross section of AJAX gasket with ¼" flange designed for 1,100 PSI. Note increased number of plies.

"THE STORY BEHIND THE GASKET THAT BREATHES"

AJAX Gaskets, constructed of one continuous strip of preformed metal wound spirally from the inside to the outside, are engineered to withstand the most severe service conditions in pressure groups to 3500 psi, together with the extreme temperature ranges encountered in superheated steam.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

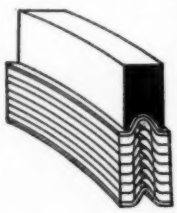
The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions — and retains the positive, secure seal you require at all times.

BOILER HANDHOLE, TUBECAP AND OTHER BOILER ACCESSORY GASKETS

AJAX Style "A" Boiler Gaskets are constructed for three major pressure groups — 0 to 499 lbs., 500 to 999 lbs., and 1000 lbs. and up — through modification of the number of spiral wound metal plies per diameter. AJAX Style "A" Gaskets provide these inherent advantages:

1. Excessive strain on fittings eliminated. Style "A" Gaskets seal under a comparatively low bonding load.
2. Knife edge, interlocked plies of metal between flanges act as automatic expansion member compensating for pressure fluctuations.
3. Higher safety factor, since each gasket is constructed for specific operating conditions.
4. Boiler "outage" time is held to a minimum.
5. Springback quality of AJAX Gaskets assure their satisfactory performance when re-used.

STYLE "S-R" METAL-ASBESTOS FLANGE GASKETS



Style S-R Gaskets for Raised Face, Smooth Face, Crane Lap or Van Stone Joints, consist of standard AJAX Spiral Wound Gaskets .175" thick inserted into a solid steel reinforcing ring .125" thick. The reinforcing ring prevents lateral expansion due to compression and acts as a centering device to insure positive location; also as a compression gauge, since the inside diameter of the ring actually rests between the flange bearing surfaces, thereby preventing overloading of the flange studs during installation. Like all other gaskets listed, this style is scientifically designed to seal with a minimum of bolt loading within stress limits for specified bolting arrangements established for fittings in all pressure groups. Gasket and ring are installed as a single unit. Gasket is easily removable for replacement.

AJAX BOILER MANHOLE GASKETS

Style M-H — Three basic pressure groups — 0 to 499 lbs., 500 to 999 lbs. and 1000 lbs. up. Stainless Steel is recommended for use where pressure exceeds 500 lbs. M-H gaskets seal under comparatively low bonding loads. A maximum 1" flange width will accommodate most every service condition encountered in any pressure group. ¼" and ⅛" thicknesses.

Style C-R — The Style C-R Manhole Gasket is self-centering and is in frequent demand for use on boiler manhole plates where chamfer is encountered between the shoulder and the flat of the bearing surface. The centering ring in this assembly is slightly thinner than the gasket itself; assures positive location between two flats. ¼" thickness only.

Style H — Original thickness of gasket is .175" ± .005". Constructed to seal at a compressed thickness of .125" ± .010" with a minimum of bolt loading within stress limits for specified bolting arrangements established for fittings in all pressure groups. Gasket resiliency compensates for stud relaxation, and also for variations in pipe line stresses. The wire guide assures ease of installation and locates the gasket in a positive position.

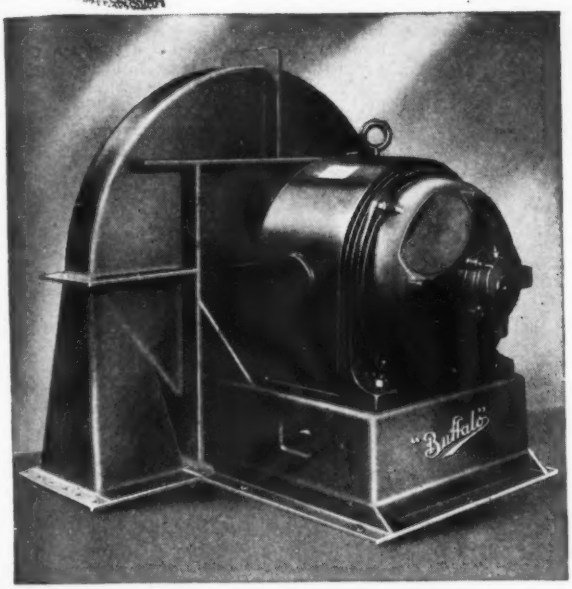
U.S. GASKET CO.

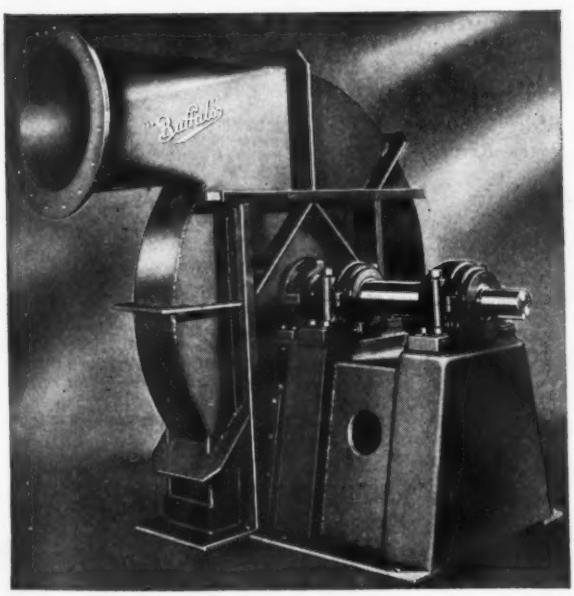
SEE OUR CATALOG IN SWEET'S

1592 PIERCE AVENUE
CAMDEN, N. J.

Distributors
IN PRINCIPAL CITIES
* * *
A few choice industrial territories are open

SOMETHING NEW IN HIGH PRESSURE AIR DELIVERY





These new Buffalo Centrifugal Compressors give up to 4 lbs. pressure per square inch in a single stage. Because each unit is designed to fit the exact operating conditions, peak efficiency at that condition is practical.

For handling air to oil or gas furnaces, on high pressure installations in glass, steel and chemical plants, for scale and water blowoff problems and all kinds of experimental work Buffalo Centrifugal Compressors offer unusually low-cost, high-pressure air.

Welded steel or alloy rotors used were developed as a result of tests in the Buffalo Vacuum Test Pit. If you have use for high pressure air, why not write today for Bulletin 3553 which describes these units.

BUFFALO FORGE COMPANY

488 Broadway **Buffalo, N. Y.**

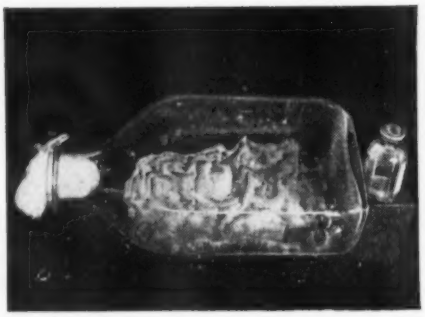
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

ARMY E NAVY

"Buffalo"

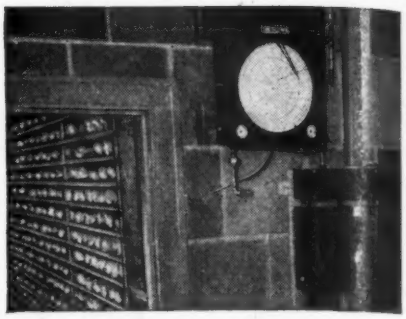
"First For Fans"

CENTRIFUGAL COMPRESSORS



1. Quart flask containing Penicillin culture after seven days of incubation. The small bottle on the right is about ¼ full of liquid Penicillin, the only portion that is used for medicinal purposes. It takes many of the larger flasks to produce the small quantity contained in this bottle.

2. Starting growth of Penicillin. In this small, sterilized and enclosed room, the operator feeds powdered Penicillin culture into the flasks containing a corn starch base mixture. The flasks are then sent to the incubation room.



3. One of the many incubation rooms. Flasks remain here for seven days of incubation to produce the mold growth shown in the first picture. At upper right, outside the incubation chamber is a Brown recording controller that maintains the required constant temperature during incubation.

Penicillin

Production Only Possible with Controlled Temperatures

Penicillin has been called the modern miracle of chemotherapy. Since the news of its discovery was released to the world, just before Pearl Harbor, it has saved thousands of our soldiers' lives and limbs. And, according to medical scientists, its future possibilities in combating infections and infectious diseases are almost unlimited.

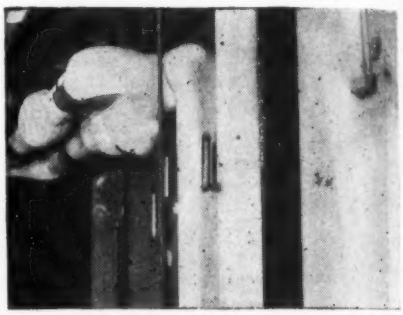
In the manufacture of Penicillin on a commercial scale, accurate temperature and humidity control is one of the most vital factors. In fact, technicians say it would be impossible to maintain the rigid standards of quality in the quantities in which it is now being manufactured, without the sensitive and accurate control of temperature and humidity that is made possible by the use of Minneapolis-Honeywell thermostats and Brown precision instruments.

Pictured here are the important steps in the production of Penicillin by one of America's leading biological and pharmaceutical manufacturers — the Lederle Laboratories at Pearl River, New York.

* * *

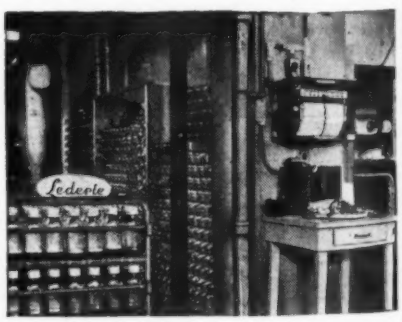
Minneapolis-Honeywell temperature controls are now busy on thousands of war production jobs. After complete victory they will continue their leadership in the control of all kinds of manufacturing processes where temperature and humidity are vital factors. Brown Instrument Co., Philadelphia, Pa., a subsidiary, and Minneapolis-Honeywell Regulator Co., 2702 Fourth Avenue So., Minneapolis 8, Minn. Branches and distributing offices in all principal cities.

MINNEAPOLIS **Honeywell**
CONTROL • SYSTEMS



4. Main air conditioning system which supplies conditioned air to the incubation rooms. At right is a Minneapolis-Honeywell thermostat for controlling dewpoint temperatures.

5. Sealing Room, where small bottles of liquid Penicillin are sealed after removal from the refrigeration room. They are now ready for shipment. The sealing room is maintained at constant temperature by the Honeywell thermostat at upper left.



6. The beginning of another cycle. Emptied flasks are brought into this room on a conveyor belt, the flasks are cleaned of mold, washed, sterilized and refilled with the corn starch base solution. Mounted on the wall, over the small table, is a Brown recording potentiometer which accurately records the temperatures maintained during the process of production.

GRAPHITE GUS SAYS:

IT'S A JOB FOR GRAPHITE

to prevent failure of ordinary oil and grease

Use DIXON'S Lubricating Graphite on the tough spots. Rub it on dry. Add it to your regular oils and greases.

Dixon's Ticonderoga Lubricating Flake Graphite. Sleeky, large flakes or medium powdered, this graphite gives sustained friction freeing lubrication on packings, large free-fitting bearings, open gears, sprockets, chains and other heavy duty equipment. Add it to oils and greases to fortify them against extremes of temperatures, and pressures. It lengthens lubricant life. Data Sheet #5 tells where and how.

Dixon's No. 635 Lubricating Flake Graphite. This finely powdered graphite is particularly suitable for close-fitting bearing surfaces and mechanisms operating under high temperatures, pressures and speeds. It is extremely unctuous and is used dry. Added to oils and greases it lengthens their life and makes better friction fighters. Data Sheet #6 illustrates uses.

Dixon's Microfyne Lubricating Flake Graphite. Being microscopic in particle size, this lubricating flake graphite is especially processed to meet the largest variety of applications. As a co-lubricant in plain oils and greases it enables them to stand up under conditions of extreme heat, cold, speeds and pressures. Used dry it quickly establishes a friction-free surface. Data Sheet #7 shows other uses.

Dixon's Graph-Air Gun, Type 4. Handily blows its contents of dry Microfyne Graphite into locks and all close-fitting mechanisms. Provides long lasting lubrication that's exceptionally resistant to conditions that destroy ordinary lubricants. This powdered graphite will not gum or dry out. In plant, office, home, Dixon's Graph-Air Gun is the most useful lubricator ever. Data Sheet #8 lists many of its 1001 uses. Get your gun at Supply or hardware store—30¢.

DIXON'S GRAPHITES
FOR LUBRICATION · HEAT CONDUCTION
HEAT AND COLD RESISTANCE · ELECTRICAL CONDUCTION
PROTECTIVE COATINGS and PAINTS

ANSWERS!
HELPS! HINTS!

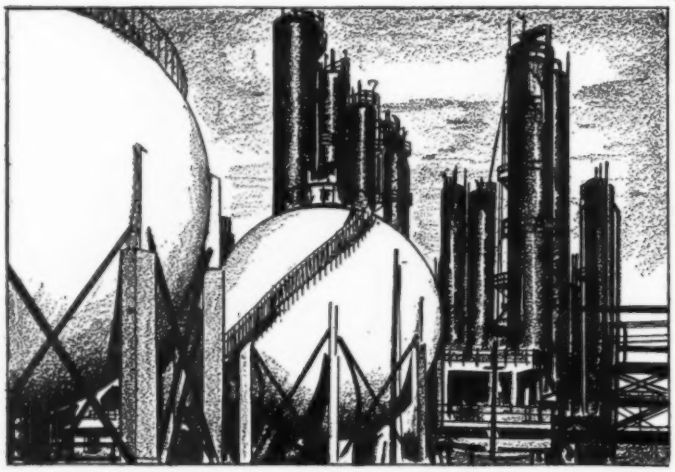
For help in a tough lubrication problem, Write Graphite Gus for illustrated Data Sheets on the product or products that interest you. They tell how and where you can make Graphite do the job—Better.

JOSEPH DIXON CRUCIBLE COMPANY

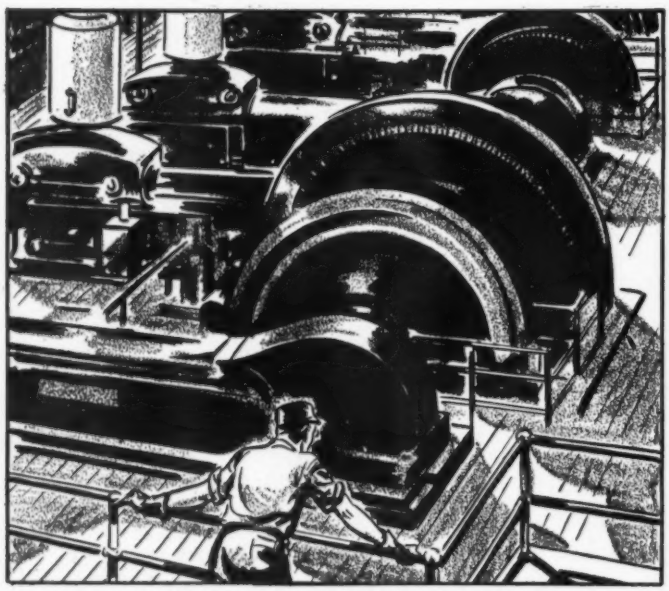
DIV. 94C7 JERSEY CITY 3, NEW JERSEY

Do you know that . . .

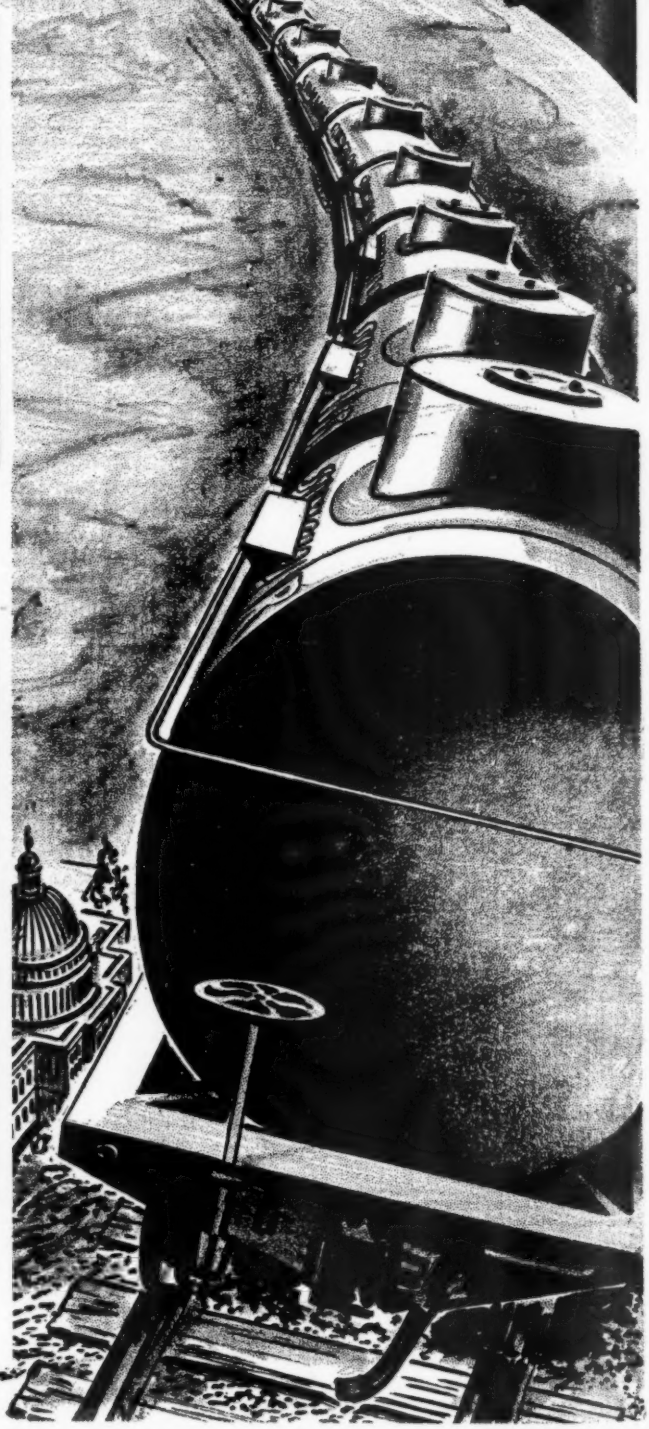
A TANK CAR TRAIN STRETCHING FROM WASHINGTON TO QUEBEC WOULD BE REQUIRED TO CONTAIN A SINGLE YEAR'S PRODUCTION OF CRUDE OIL FROM SINCLAIR'S 8000 WELLS.



SINCLAIR RUBBER INC., A SINCLAIR SUBSIDIARY, MANUFACTURED IN ONE YEAR SUFFICIENT BASIC MATERIAL TO PRODUCE 78,000 TONS OF SYNTHETIC RUBBER. THIS PLANT AT HOUSTON, TEX., IS SINCLAIR OPERATED FOR THE GOVERNMENT.



LUBRICATION FOR FULL DELIVERY OF POWER UNDER CONTINUOUS HEAVY DUTY OPERATION IS PROVIDED BY SINCLAIR STEAM CYLINDER AND VALVE OILS. THEY SUIT ALL ENGINE DESIGNS AND OPERATING CONDITIONS.



SINCLAIR IS EQUIPPED TO SERVE YOU BETTER!

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Arsenic as a Corrosion Inhibitor

Destroying the Myth of Intercrystalline Attack

The use of arsenic as a dezincification inhibitor for Admiralty condenser tubing and 70-30 brass was reported as far back as 1924 by the well-known metallurgists, Bengough and May in the British Institute of Metals as part of the Seventh Report to the Corrosion Research Committee of the Institute of Metals (British). This discovery attracted worldwide attention because of their masterly work on the mechanics of dezincification and methods of preventing it. Aside from arsenic they also found that "tin, nickel, tungsten, antimony and aluminum all had the same kind of effect as arsenic but less intense and in the order named."

As a result, arsenic which they considered the most effective inhibitor of dezincification is now added in amounts up to 0.04 percent to brass condenser tubing as standard practice by British manufacturers. It was also adopted as standard practice by Bridgeport Brass Company and most of the larger American manufacturers about 1936. These investigators also developed aluminum brass for condenser tubes and included arsenic as an inhibitor.

Recently, investigations by two American manufacturers indicated that antimony and phosphorus are corrosion inhibitors. In obtaining their U. S. patents for adding these other dezincification inhibitors, the inventors claimed that their inhibitors are superior to arsenic because they prevent the occurrence of "intercrystalline attack" which they stated is characteristic of brasses containing small amounts of arsenic added intentionally to prevent dezincification. Their claims were based on accelerated corrosion tests which were conducted with solutions of several concentrations of cupric chloride. No experiments under actual service conditions, as found in seaboard power plants, marine condensers, heat exchangers and oil refineries, were conducted to substantiate any of their claims.

In recent months we have come across rumors to the effect that Arsenical Admiralty is subject to "intercrystalline attack" and naturally we wish to run them down. In Bridgeport Brass Company's long experience, as well as in the experience of other companies who have been manufacturing arsenical Admiralty condenser tubes for many years, no evidence of the mythical "intercrystalline attack" has been found. Several laboratory investigators, using cupric chloride, as the attacking agent, have reported the development of intergranular cracking in both Arsenical Admiralty and plain Admiralty.

Recently we checked with a prominent authority as to British practice and experience and received the following:

"The beneficial effect of small amounts of arsenic in brass in preventing dezincification of the alloy has been widely known for many years. In this country it is, and has been for several years, quite a common practice to add arsenic to the extent of about 0.02—0.04 percent not only to aluminum brass, but to other brass alloys for the manufacture of condenser tubes.

"We are not acquainted with any evidence arising either in the course of experiments or in service which would indicate that the presence of this amount of arsenic is in any way injurious or detrimental to the alloy, or that it gives rise to any kind of intercrystalline failure."

Regardless of the use of other corrosion inhibitors besides arsenic which are being advocated by some manufacturers, Bridgeport Brass Company intends to continue to supply Arsenical Admiralty, Arsenical Muntz, and Arsenical Aluminum Brass because experience has shown that the addition of arsenic is excellent as a dezincification inhibitor. We have yet to run across a single case of intercrystalline attack and would appreciate it if our friends will help us spike the rumor or bring the offender out in the open where we can all take a good look at it, if it is in existence.

Cupro Nickel Now Released For General Use

It has been announced that limitation order L-154 schedule II which restricted the use of cupro nickel tubes in steam surface condensers has been revoked, and that cupro nickel is now available for general use.

70-30 cupro nickel condenser tubing made to Navy specifications 44T39a, is the standard alloy specified by the U. S. Navy for all battleships and many other types of vessels. Besides excellent resistance to impingement attack, this alloy withstands erosion and corrosion in most cases better than brass. It was adopted by the Navy after numerous tests indicated that Admiralty condenser tubing could not stand up satisfactorily for fast steam turbine-propelled vessels which depend on condensers that produce a high vacuum and operate with high water velocities. Under such conditions tubing is exposed to both corrosion and erosion caused by the impingement of air bubbles associated with water of high velocity and turbulence. 70-30 cupro nickel made to Navy specifications 44T39a fulfills the requirements of the U. S. Bureau of Ships which calls for the presence of 0.6 maximum percent iron and over 0.5 percent manganese.

70-30 cupro nickel withstands elevated temperatures better than brass and is used for feed water heaters, heat exchangers and evaporators where good corrosion resistance is imperative. This alloy is said to be immune to season or stress corrosion cracking caused by the combined action of moist ammonia, oxygen, stress and time. Since cupro nickel has a lower specific thermal conductivity than brass, some designers of condensers provide 10 percent additional condensing surface as compared to brass tubes, to allow a safe margin for this difference. However, there are engineers who claim that the thermal conductivity has little bearing on the rate of heat flow from one fluid to another through such a metal wall.

Because this alloy has superior properties to most metals and alloys, cupro nickel is being carefully considered for many applications involving corrosion too severe for ordinary metals. This is in line with the present tendency to fight the ravages of corrosion with better materials which may be higher in first cost, but which are most economical when length of service and reduction in maintenance are taken into account.

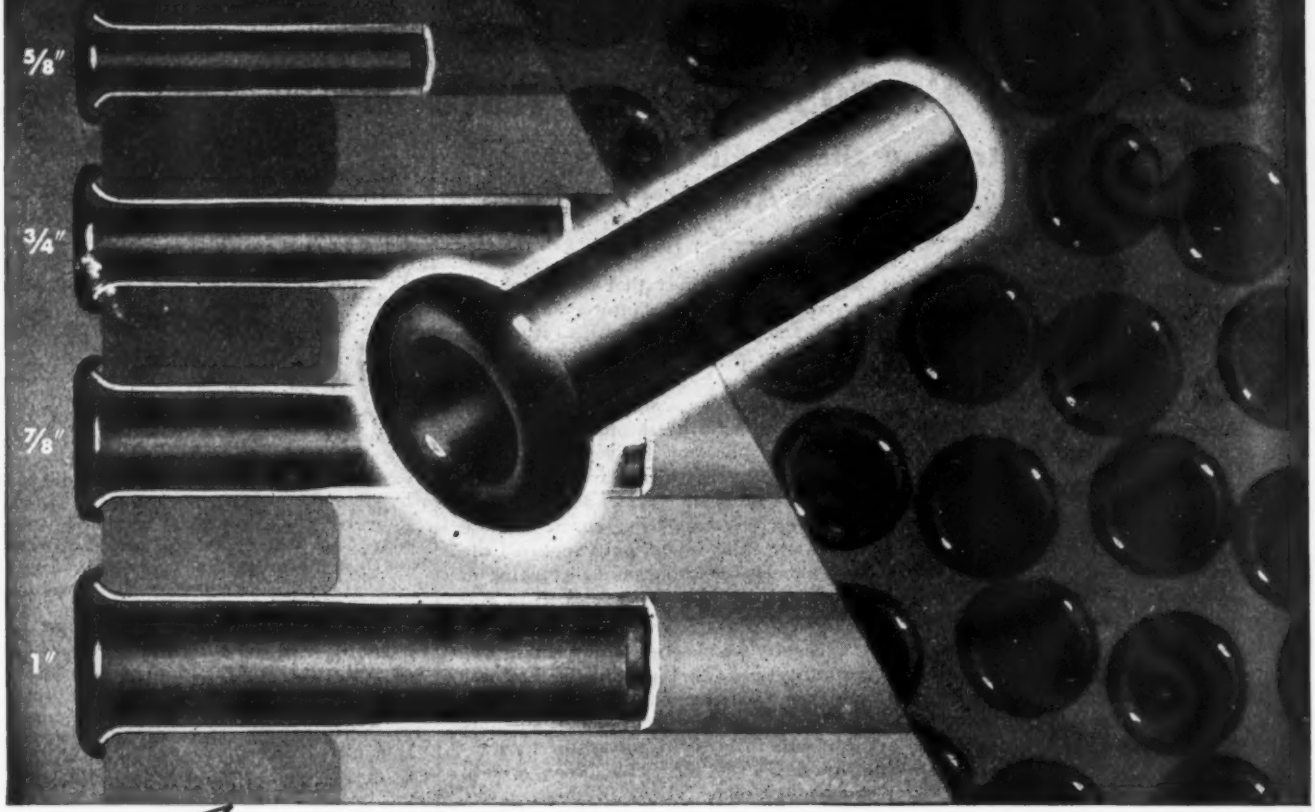
Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ESTABLISHED 1865

Save CRITICAL TUBE METAL



Install JOHN CRANE
CONDENSER TUBE PROTECTORS

The inlet end of the condenser tube is most often the first section to fail. This is the area most vulnerable to air impingement and sand abrasion. Service Tests in Marine and Stationary Condensers prove that John Crane Condenser Tube Protectors *armor the entrance section; greatly lengthen tube life.* Note these other important advantages:

- **Molded of a hard, wear-resistant plastic material**
- **Resist contaminated salt or fresh water**
- **Unaffected by temperatures to 275° F.**
- **Provide a belled mouth for inlet tube ends; reduce turbulence**
- **Easily installed on both old and new tubes**
- **Last for life of tubes**

John Crane Condenser Tube Protectors are inexpensive to install; and require no special tools. Available for 5/8" and 3/4" 16-BWG, or 5/8", 3/4", 7/8" and 1" 18-BWG tubes. For full information send for *illustrated* bulletin, or consult our branch office *nearest you.*

CRANE PACKING COMPANY

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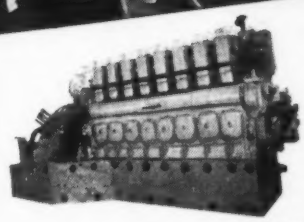
CRANE PACKING CO., LTD., Hamilton, Ontario, Canada.
Branches: Montreal, Toronto, Vancouver

They're helping to rebuild Russia...

the same **ENTERPRISE** Turbocharged Diesels that offer you dependable, money-saving power!



Thirty Enterprise DSG-38 Diesel Engines, rated 900 HP at 428 rpm, are at work in the rebuilding of Russia. Each generator set, producing 600 kw, is installed in a railroad car.

● From Stalingrad westward, history's greatest reconstruction task is underway. New communities arise from the ashes . . . modern communities depending on uninterrupted electric service.

Enterprise Turbocharged Diesels are on the job. Thirty powerful Enterprise engines, each turning a generator capable of supplying all the needs of a modern community of 2700 people, have been on the job since the Nazi tide was turned at Stalingrad.

Installed in railroad cars, these Enterprise Diesels are built to do a maximum job in a minimum space. They are operating in sub-zero weather . . . burning sub-standard fuels including heavy oils. Simple to operate and maintain, they have met the major requirement . . . dependability.

Enterprise Turbocharged Diesels can supply the power YOU need . . . easy-to-operate power for YOUR specific job. Enterprise Turbocharged Diesels are built to handle your power requirements with an extra margin of dependability . . . long-lasting dependability.

For a clear explanation of the many benefits Enterprise Turbocharging offers you, write for booklet. Address Department R-1.

ENTERPRISE TURBOCHARGING GIVES YOU . . .

More power per cylinder • More power per gallon of fuel
More power with less weight • More power in less space

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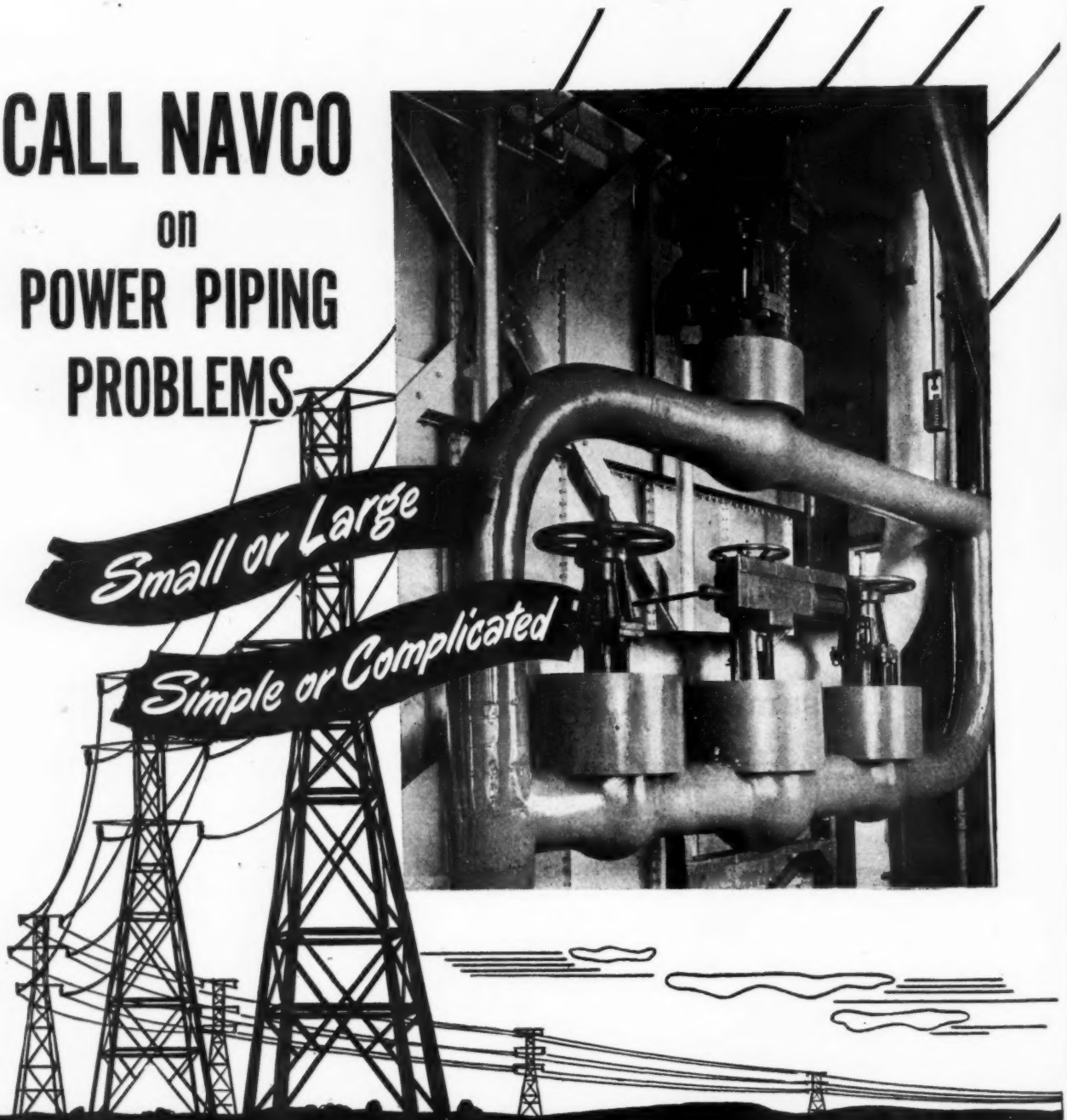
on
POWER PIPING PROBLEMS



Whatever your Piping problem may be, Navco is in position to help you. The knowledge which we have gained in the past 36 years has not been confined to design and fabrication alone. It includes a wide field of experience in erecting and testing Piping Systems for every Service.

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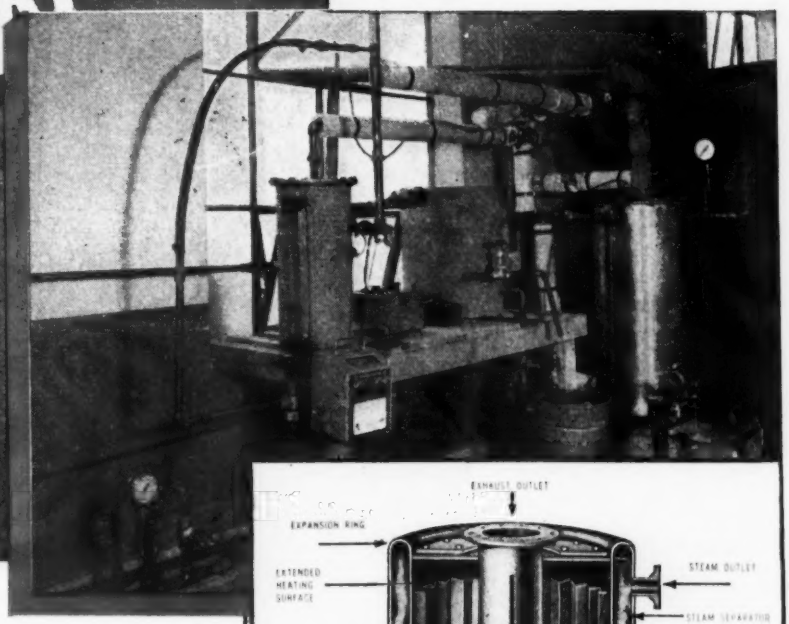
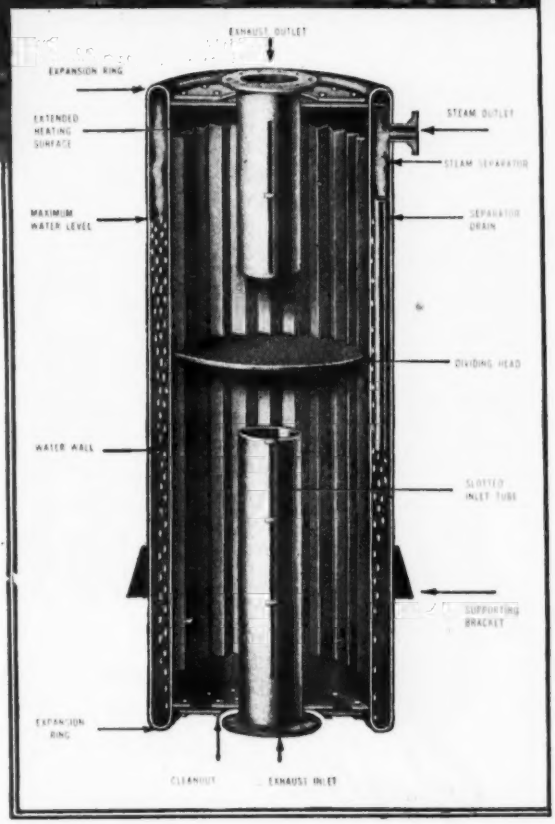
NAVCO

NAVCO PIPING

PUT EXHAUST HEAT TO WORK

WITH MAXIM HEAT RECOVERY SILENCERS





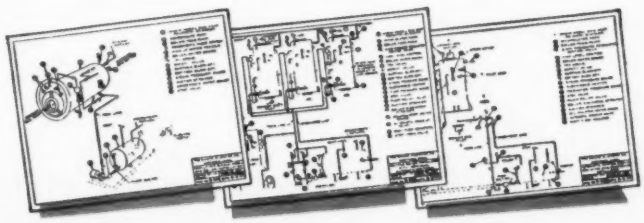
The illustration above shows a test hook-up for Heat Recovery Silencer research in the Maxim Research Department. Here again, as in Maxim Silencers, the basis for superior performance is constant and painstaking research which results in proper basic design and a never ending search for improvement.

Maxim Heat Recovery Silencers provide effective silencing of exhaust noise, 100% spark arresting (where this is desired) and the recovery of waste exhaust heat to produce steam or hot water for heating or processing operations.

These Heat Recovery Silencers are available with automatic controls which control steaming rate by varying water level in the water wall of the Silencer. They may be run wet or dry. Highly efficient heat transfer is assured by the Maxim extended heating surface feature.

●

For silencing without the heat recovery feature, Maxim makes silencers for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



PRACTICAL WORKING HOOK-UPS

Typical Heat Recovery Silencer hook-ups are available with a detailed discussion of each. We will be glad to send them to you. Just ask for Dwgs. B-298, B-301, B-302 and B-303.

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ARMY E NAVY

MAXIM

ORIGINAL LITHOGRAPH
by BENTON SPRUANCE

Insulate ... to cut production costs

Heat escapes—silently and unseen—from unprotected piping and equipment wherever ambient temperature is lower than that of the equipment itself. And these heat losses, even over a short period of time, add up to surprising amounts. They are a hidden tax on your cost of doing business.

Every avenue of escape, from boiler, steam line, fitting and heated surface, can be blocked by the application of an efficient thermal insulation, such as Ehret's 85% Magnesia or Enduro. These time-tested insulating materials are easy to apply, not readily damaged by shock or seepage, and maintain their high efficiency throughout their service life. For upwards of fifty years they have been known and widely used throughout industry.

THE EHRET HEAT INSULATION HANDBOOK *contains a wealth of information on 85% Magnesia, Enduro high temperature and many other insulations—with selection and application data for boilers, piping and equipment. Fully illustrated, it includes heat loss and efficiency tables, specifications and recommendations for every temperature condition. A copy will be sent at your request.*

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VALLEY FORGE • PENNSYLVANIA

Used in the

MOST ADVANCED STEAM LOCOMOTIVES

of every period . . .

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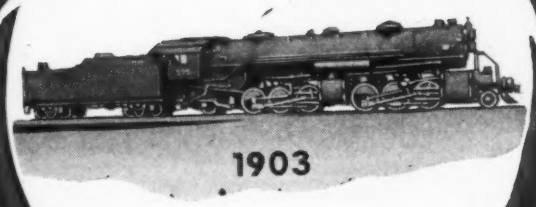
BOILER TUBES



1903

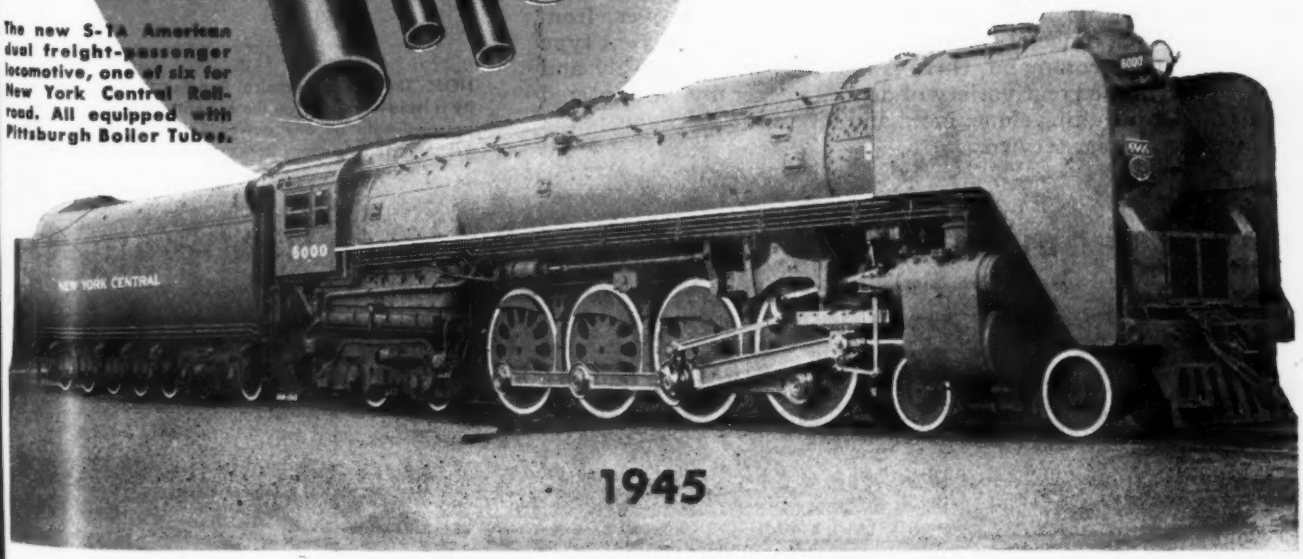
The complete dependability which has characterized *Pittsburgh* Boiler Tubes for 42 years, fully qualifies them for service in the great new *American* built, dual-purpose locomotive, "The Niagara." First of a number of such giants of the rails built for *New York Central* to handle both fast passenger and freight, approximately *4700* feet of *Pittsburgh Seamless* tubes her tremendous boiler.

Pittsburgh Seamless has helped advance the progress of *transportation* not alone in boiler tubes used in the railroad and marine field but in varied and equally important applications in the automotive and aviation industries. From the successful A.R.A. approved Tubular Railway Axle to the selection of Boiler Tubes for this advanced steam locomotive, confidence in the integrity of *Pittsburgh Seamless* is based on demonstrated superior quality.

PITTSBURGH STEEL COMPANY

1659 GRANT BUILDING PITTSBURGH, PA.

The new S-1A American dual freight-passenger locomotive, one of six for New York Central Railroad. All equipped with Pittsburgh Boiler Tubes.

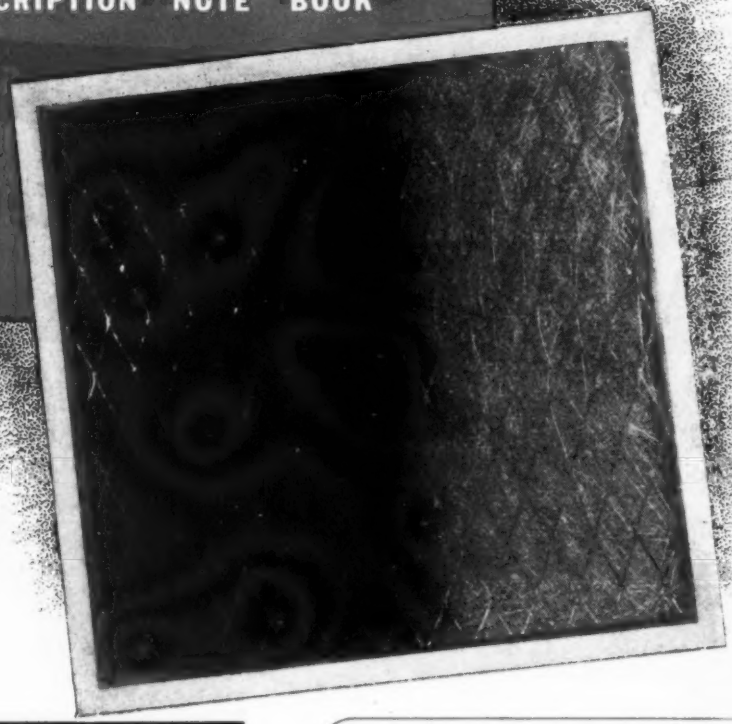


1945

PAGE 1

OAKITE "PRESCRIPTION NOTE BOOK"

ONE OF A SERIES of data sheets for power plant engineers outlining various Oakite maintenance and equipment cleaning tasks. Each sheet may be filed for reference to serve as a reminder for obtaining more specific information.



Cleaning Washable Type AIR FILTERS

FREQUENT cleaning of dry or viscous washable-type air filters is recommended to assure full filtering capacity. Operating conditions, dust load, type of impinged soil, adhesive and other deposits to be removed, including equipment available, generally determine the Oakite material and method recommended. Additional factors are whether filter mats are ferrous or non-ferrous metal or are fabricated from glass wool, spun glass or similar material.

Oakite Alkaline, Acidic and Solvent Materials Designed For Filter Cleaning

Whatever the type of air filter employed in your air conditioning equipment, the successful experience of Oakite Technical Service Representatives can prove valuable and helpful to you in handling this work on a low-cost, efficient basis. Moreover, from among the wide range of Oakite alkaline, acidic and solvent type materials at his command, there is one that will effectively and safely remove the great variety of deposits generally encountered in air filters, including slime, mold and lime scale. Write us today . . . we are at your service.

Other Power Plant Cleaning Jobs for OAKITE

Automatic Filters . . . Electrical Precipitators . . . Controlling Slime and Scale Formation in Air Wash Air Conditioning Units . . . Cleaning Evaporative Condenser Coils . . . Controlling Slime and Mold in Humidifying Systems . . . Cleaning and Descaling Diesel or Gasoline Engines . . . Cleaning and Descaling Jacket Water Coolers and Lube Oil Coolers . . . Cleaning Surface Condensers . . . Cleaning Water and Steam Condensate Meters . . . Descaling Water Cooled Compressors . . . Cleaning Unit Heaters . . . Descaling Ammonia Condensers . . . Cleaning Transformers . . . Cleaning Painted Surfaces of Equipment . . . Stripping Paint . . . Cleaning Floors.

NOTE: The Oakite Technical Representative in your locality is ready to give you the benefit of his experience and personal help on any power plant cleaning or related problem. This Advisory Service is free.

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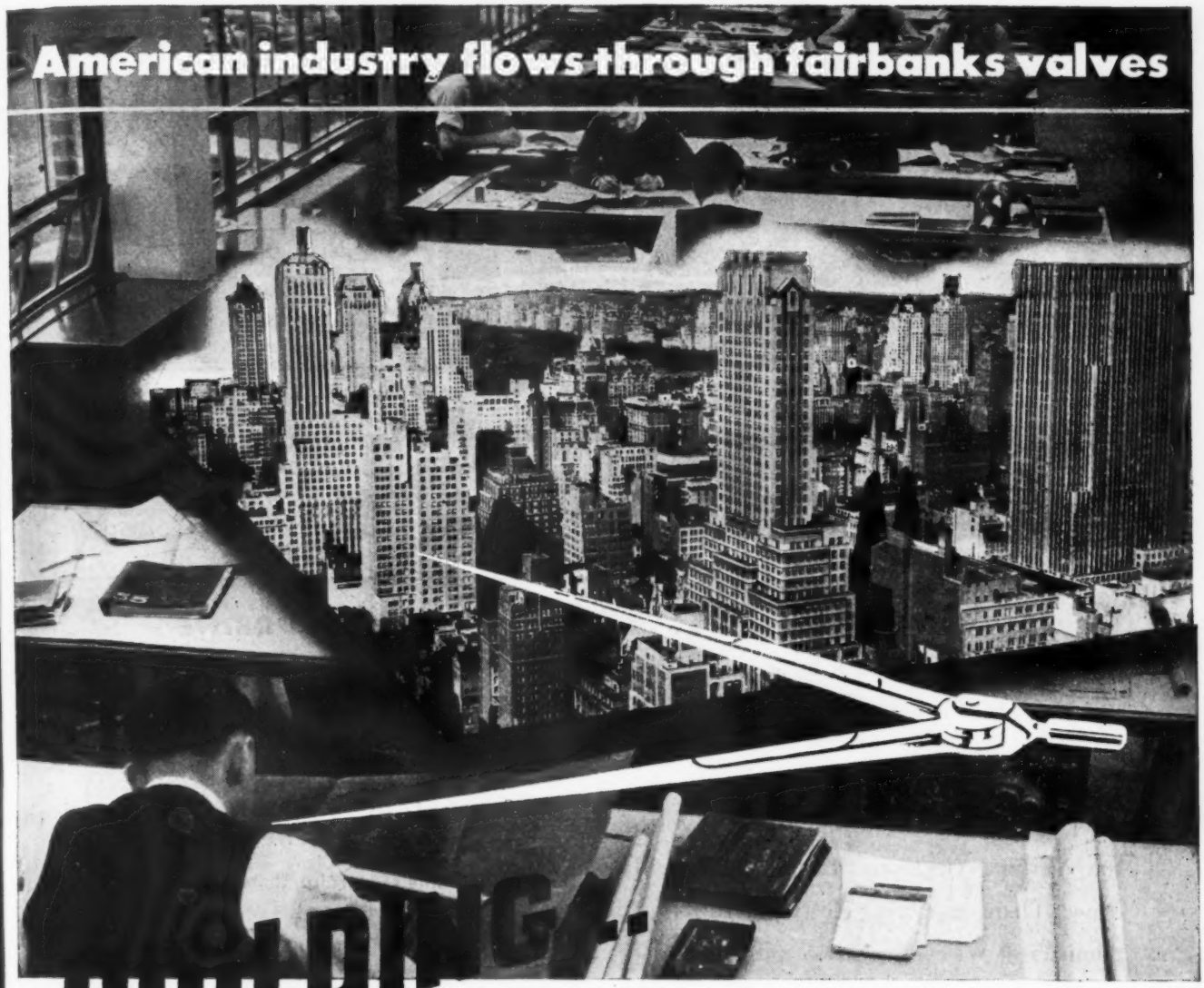
Technical Service Representatives in All Principal Cities of the United States and Canada

OAKITE
Specialized cleaning
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

American industry flows through fairbanks valves



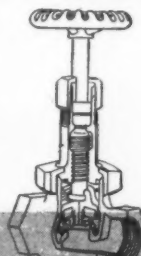
BUILDING—
tomorrow's wakening giant

After war's final "cease-firing", look for the building industry to go places . . . for vast cities-within-cities to take shape. They're on drafting boards today.

Air conditioning and ventilating will be widened to include removal of dust, bacteria and odors from the atmosphere by unit-type air sanitation equipment. On the upswing will be radiant heating, zoned heating, service hot water, spot cooling units . . . gas air conditioning which regulates humidity . . . a single heat pump system which heats buildings or cools them as desired.

Controlling liquids and gases in miles-on-miles of tomorrow's piping will be thousands and thousands of Fairbanks Valves. They will have been selected because of topflight past performance . . . because architects and engineers know they can expect freedom from failure when a Fairbanks is installed.

Whether it's a small bronze valve or a huge iron body gate valve with a 24-inch opening the name Fairbanks stands for sound engineering, careful chemical and metallurgical control of alloys, ample metal for the job. The full line is given in catalog "42" which will be sent you if you ask for it. If you need special assistance with individual problems of valve selection and application, call on the facilities of the Fairbanks Engineering Department.



THE fairbanks COMPANY

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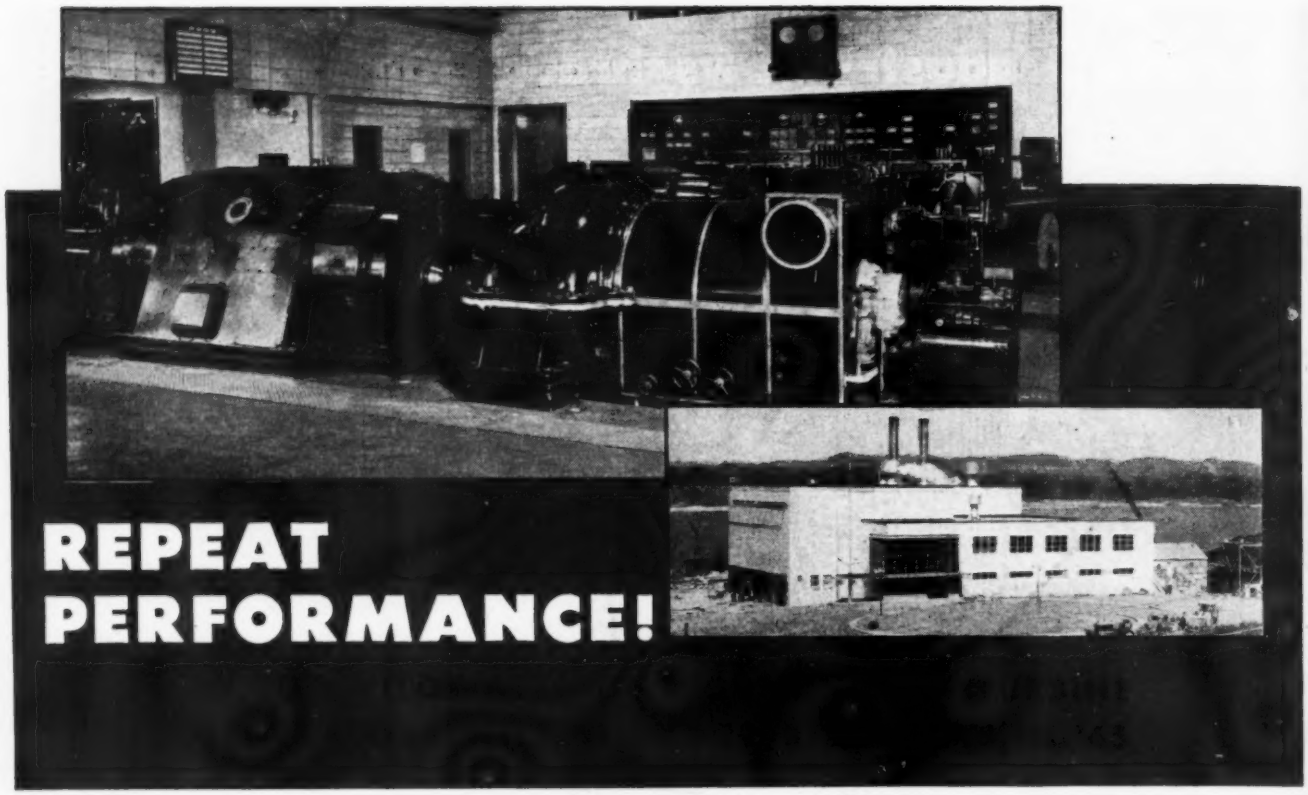
520 Atlantic Ave., Boston 10, Mass. 748 M & M Bldg., Houston 2, Texas 15 Ferry St., Pittsburgh 22, Pa.



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For the third time since 1940, Dairyland Power Cooperative is installing an *additional* Worthington Turbine Generator in its Genoa, Wisc., Power Plant, supplying electricity to farm communities of Wisconsin, Iowa and Minnesota.

One of the outstanding power cooperatives of the country, Dairyland will have 14,000 KW of installed Worthington turbine generators, when the 4000 KW unit now being built is installed.

All units operate with 650 psi initial steam pressure . . . at 825° F. . . . and exhaust to 28.5 inches vacuum. Write for complete details. *Worthington Pump and Machinery Corporation*, Moore Steam Turbine Division, Wellsville, N. Y.

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- Turbine Generator Units (up to 7500 kw.—all types)
- Multi-stage Turbines (up to 10,000 hp. —all types)
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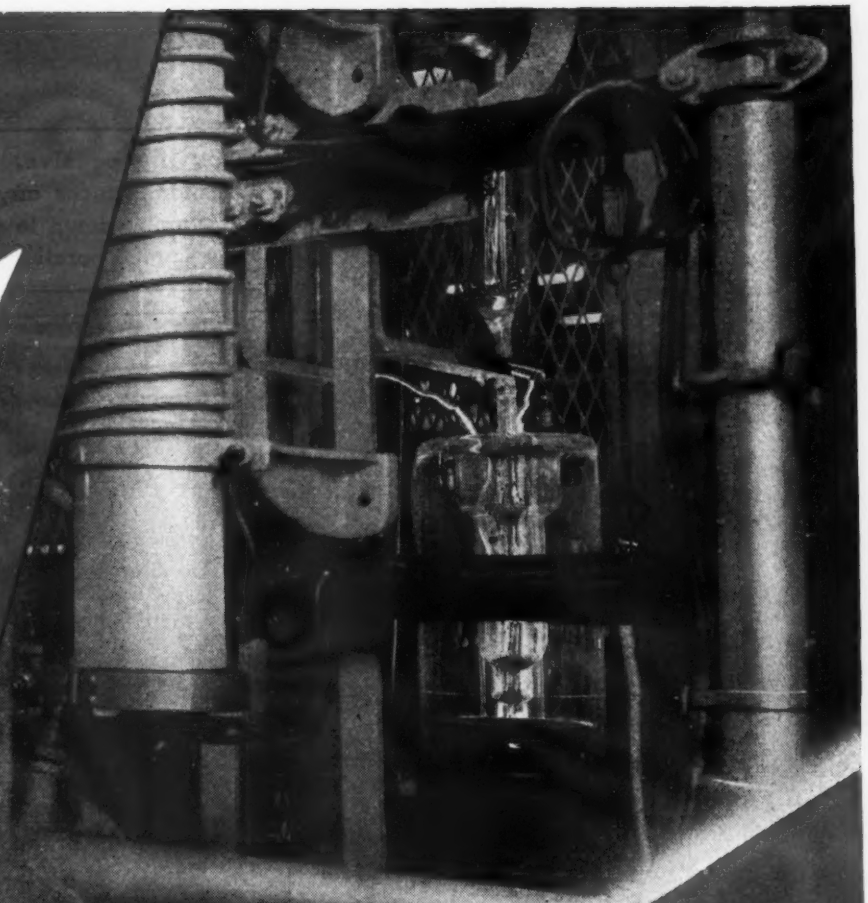
Federal Tubes...

come CLOSER to the

PERFECT VACUUM

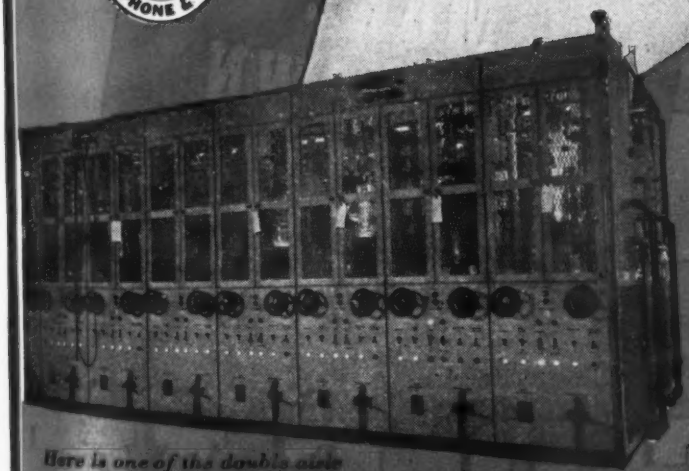


Always in the forefront of tube research and development, Federal makes another advance and now has added exhaust units of entirely new and original design to its production equipment.

This latest Federal achievement produces a tube that is substantially closer to the perfect vacuum—a tube with greater efficiency and longer life.

Arranged in banks of eight and operated with identical control equipment, these units exhaust uniformly every size of Federal tube—assuring a consistent and high standard of quality.

For any communication and industrial power tube need, turn to Federal now—test its reputation that "Federal always has made better tubes."



Here is one of the double aisle exhaust banks where 16 high power tubes can be exhausted at one time, each with individual control.

Federal Telephone and Radio Corporation

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Newark 1, N. J.

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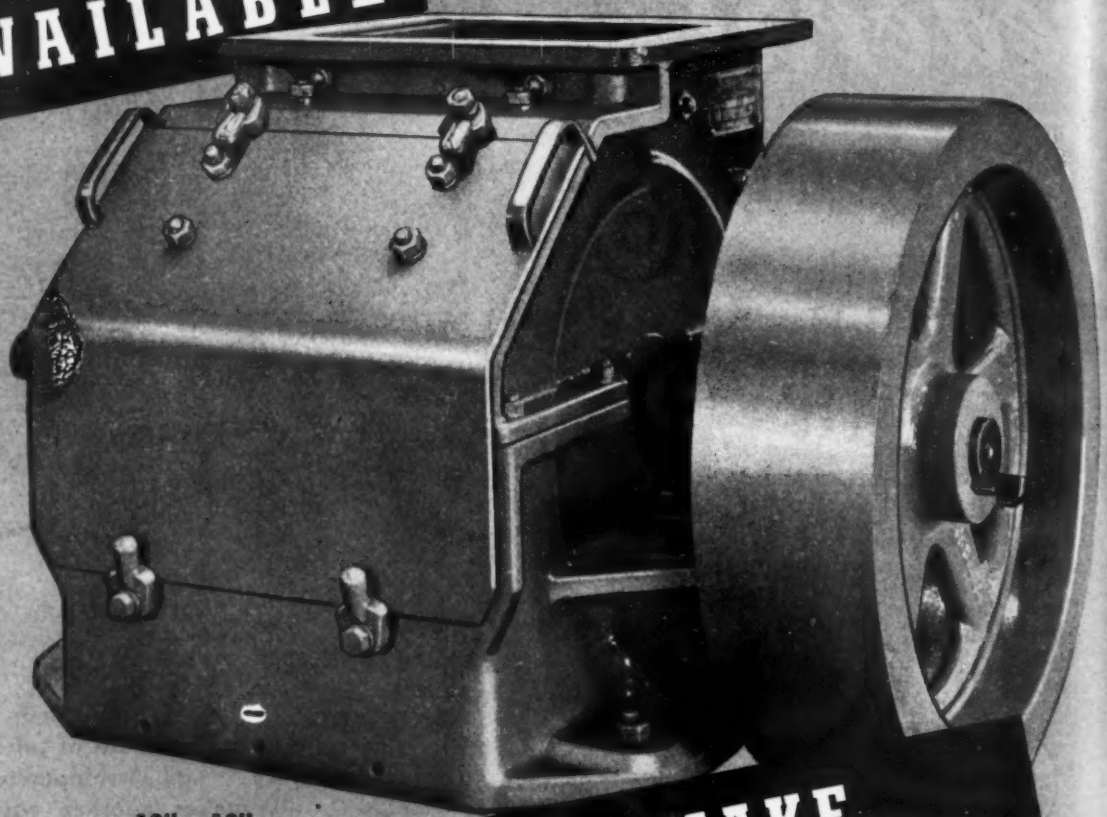
This inexpensive, small-capacity crusher reduces any coal including 10" lumps down to your stoker size in a single operation.



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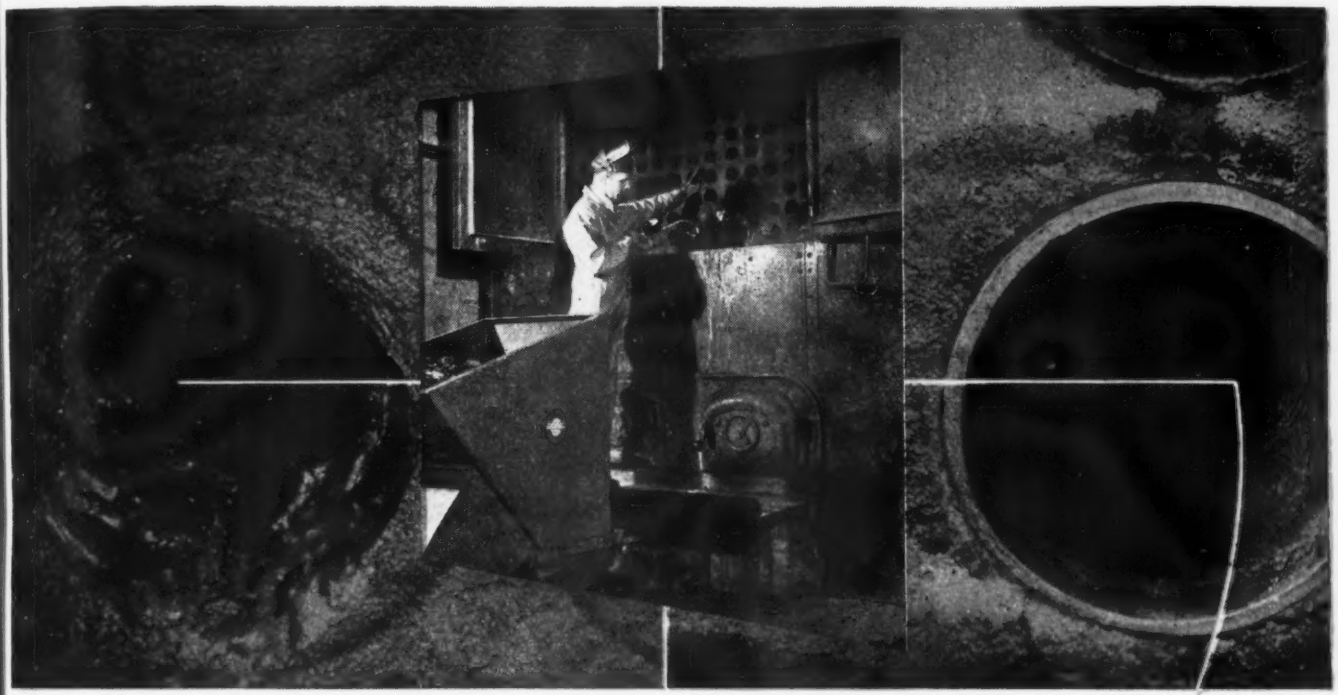

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BY SPECIALISTS IN POWER RESTORATION

Exceptional time saving and thoroughness, with complete safety! These are advantages offered you by the Dowell chemical method of removing power-stealing scales and sludges from your heat exchange equipment.

The above pictured boiler was returned to designed operating efficiency in 12 hours by the chemical removal of the calcium phosphate sludge which insulated the heat transfer surfaces. The rapid, efficient Dowell method, with a specific solvent for each deposit and type of metal, produced these results.

This example is typical. It illustrates how this pioneer service organization scientifically restores power. The complexity and size of the equipment offers no problem to Dowell engineers who have years of experience in the chemical removal of all types of scales and sludges from heat exchange units.

Dowell Service offers the additional advantages of extensive research and technical facilities of The Dow Chemical Company, parent organization of Dowell. This Dow-Dowell combination, which has been responsible for so many improvements in the methods of removing scales and sludges, will continue to better serve the plants of American industry.

Write, wire or phone the nearest Dowell office for a free estimate and your copy of "More Power to America's Industry", a new booklet containing much interesting information on Dowell Chemical Scale Removal Service.

Look to

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LARGE HIGH PRESSURE HEADER WITH WELDED VALVES READY TO SLIP INTO PLACE.

MODERN piping systems with their numerous pieces of auxiliary equipment such as valves, pumps, etc., place great emphasis on *accurate* fabrication, within very close tolerances. Such precision fabrication can only be obtained in a shop properly equipped with both facilities and personnel.

Our engineering department carefully plans each job and the layout is detailed for the most efficient shop fabrication. By pre-fabricating assemblies as large as shipping facilities and installation space will permit, testing, insurance inspection and final erection are greatly simplified and expedited.

Construction time is further saved by scheduling all work through the shop in direct relation to the sequence of erection in the field. Expensive waiting periods for material are eliminated, work progresses smoothly and the installation is completed on schedule.

In planning alterations, improvements, or replacements involving single units or complete systems for central stations, paper mills, industrial and chemical plants, contact our nearest representative or write our Engineering Department direct. They will be glad to make recommendations, without obligation.

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Walworth Lubricated Plug Valve Catalog
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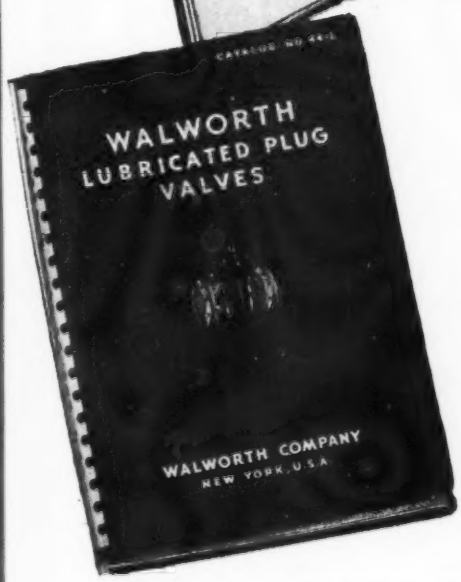

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Between the covers of this 94-page book you will find ways that Walworth can help you with your problem of handling petroleum products . . . acids . . . condensates . . . mud . . . organic solvents . . . slimes . . . slurries . . . and many other "difficult" liquids where conventional types of valves do not give satisfactory service. It is to your advantage to have this informative, important data.

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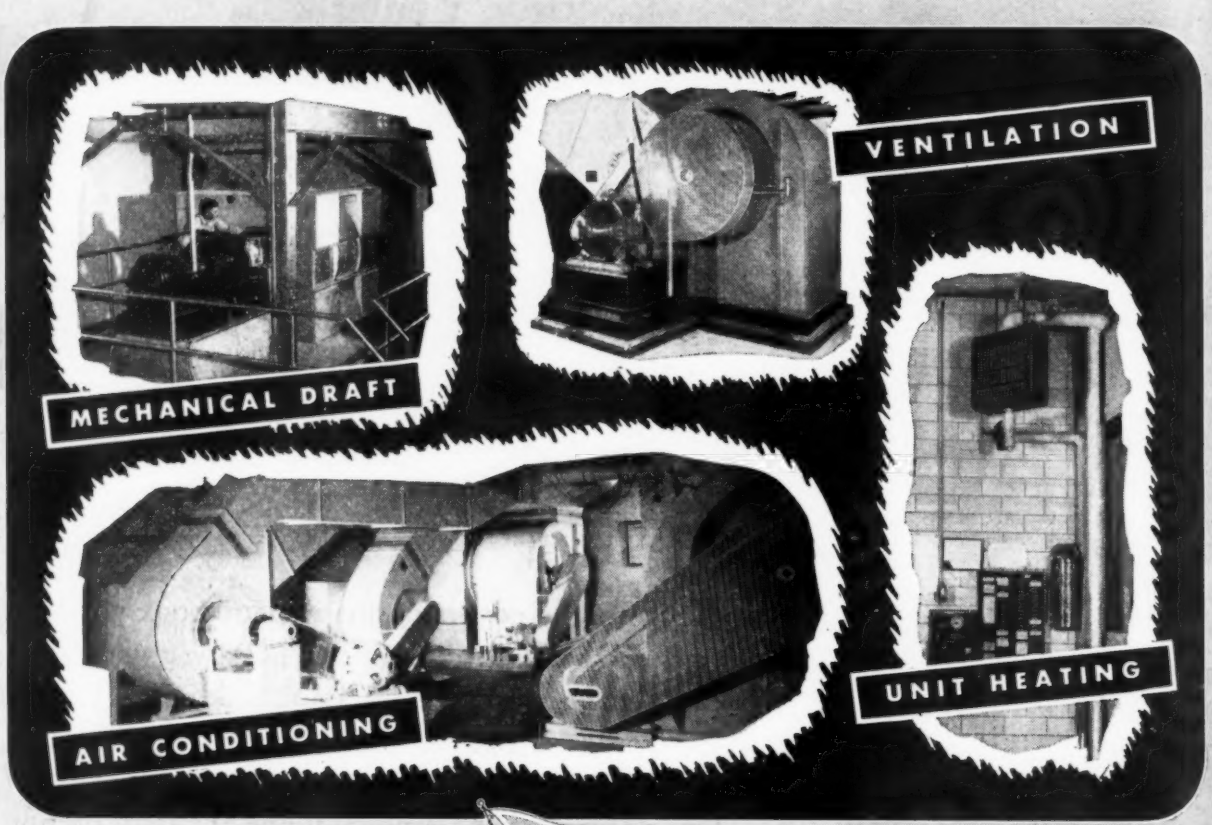
NEITHER your workers nor machines can do a creditable job, unless the air in your plant is clean, pure and correctly temperatured.

Are you letting production lag and costs mount, for want of the necessary air handling or conditioning equipment?

Thousands of plants — large and small — turn such requirements over to Clarage. We have developed, through more than a quarter-century of research and experience, the right engineering and the right equipment for any application.

Take your problem to "Headquarters" by writing or 'phoning us today. In every key city, there is a Clarage application engineering office ready to give you prompt, expert assistance.



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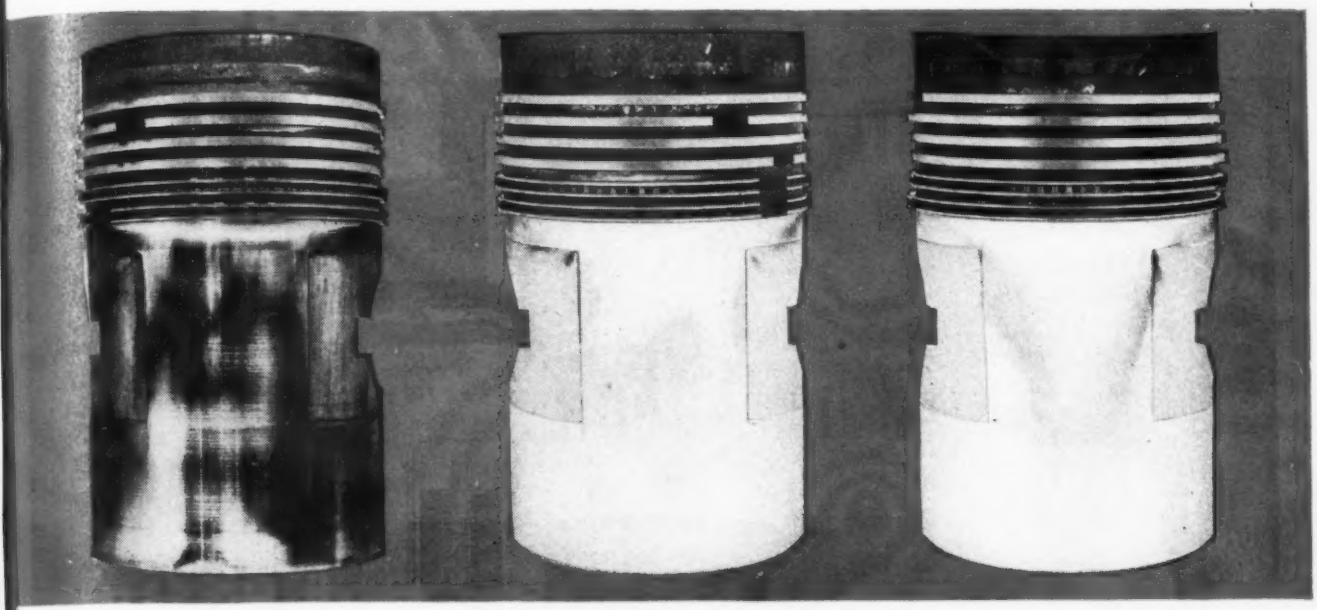
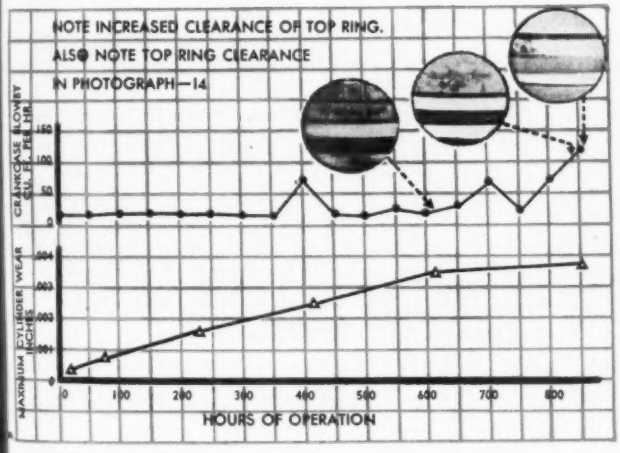
★ ★ ★ ★ ★ ★

How RPM DELO OIL prevents ring sticking

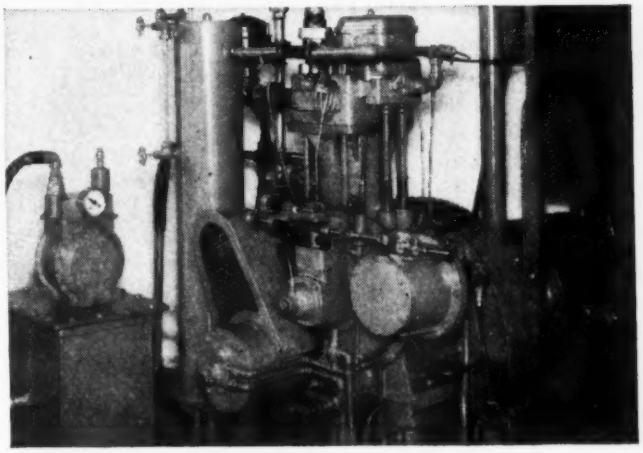


Even the finest uncompounded mineral oil will leave deposits on rings and skirts when operated under severe engine conditions. The above photo shows a test engine piston after 264 hours operation with the finest obtainable uncompounded Diesel engine oil.

Here's the same test made with RPM DELO Oil, only this time for 1000 hours—more than double the 480-hour test required in current military specifications. The photographs above show both thrust and anti-thrust sides of a piston after a 1000-hour test with RPM DELO Diesel Engine Lubricating Oil. Note that RPM DELO Oil has almost entirely prevented any deposits on skirts. Dark areas around rings are only soft carbon, not sticky varnish. The compounding in RPM DELO Oil makes this possible by preventing the initial formation of sticky varnish.


NOTE INCREASED CLEARANCE OF TOP RING.
ALSO NOTE TOP RING CLEARANCE
IN PHOTOGRAPH—14
CRANKCASE BLOWBY CU. FT./HR.
MAXIMUM CYLINDER WEAR INCHES
HOURS OF OPERATION

How blowby caused by cylinder and ring groove wear increases rapidly is shown by the above chart. Excessive side clearance caused by ring groove wear allows the ring to rock in its groove and "bite" into cylinder walls. RPM DELO Oil checks this wear at the start by an adhering agent which makes it cling to hot cylinder walls.



This single cylinder laboratory engine is used to measure the ring-sticking characteristics of Diesel lubricants. The test record of RPM DELO Oil has been confirmed by sales of millions of gallons since its development. For more technical information on RPM DELO Oil, write for Booklet T-7, Standard of California, San Francisco 20, California.

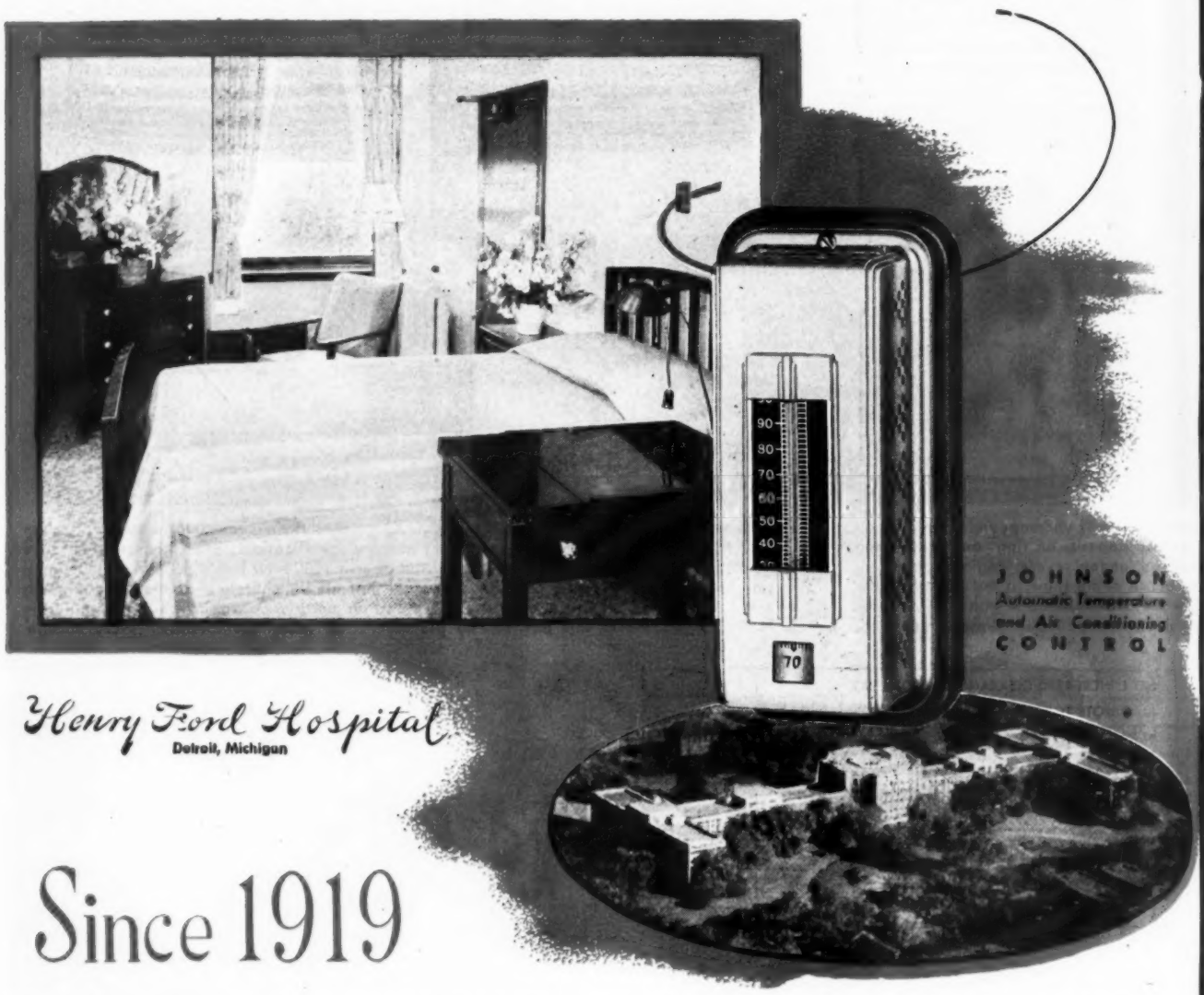
HIGH QUALITY, NATURALLY STABLE BASE OIL
Detergent compound to clean engine.
Anti-oxidant to prevent gum and sludge.
Wear-reducing compound.
RPM DELO
DIESEL ENGINE LUBRICATING OIL

STANDARD OF CALIFORNIA

RPM DELO Oil has world-wide distribution under the names: RPM DELO, Caltex RPM DELO, Kyso RPM DELO, Signal RPM DELO, Imperial RPM DELO, (CONCENTRATE)

Another Example of

JOHNSON *Individual Room* CONTROL



Henry Ford Hospital
Detroit, Michigan

Since 1919

TEMPERATURES CONTROLLED IN ALL 317 PATIENTS' ROOMS!

When the Henry Ford Hospital was planned, almost 30 years ago, no consideration was overlooked which would contribute to a highly effective hospital plant. Automatic temperature control for every radiator in the heating system was specified, with individual room thermostats in every patient's room and in all other heated spaces of this 600-bed hospital. JOHNSON Individual Room Control was selected—applied and installed by men thoroughly trained in the field of automatic temperature regulation.

In addition to control in patients' rooms, Johnson room-by-room control regulates temperatures in consultation rooms, doctors' offices, laboratories, lobbies, corridors, and all public and service areas—a total of 685 Johnson room thermostats in the Main Building of this hospital. Ventilating systems, also Johnson-controlled, serve patients' rooms, and laboratories, consistently delivering efficient service for which they were installed.

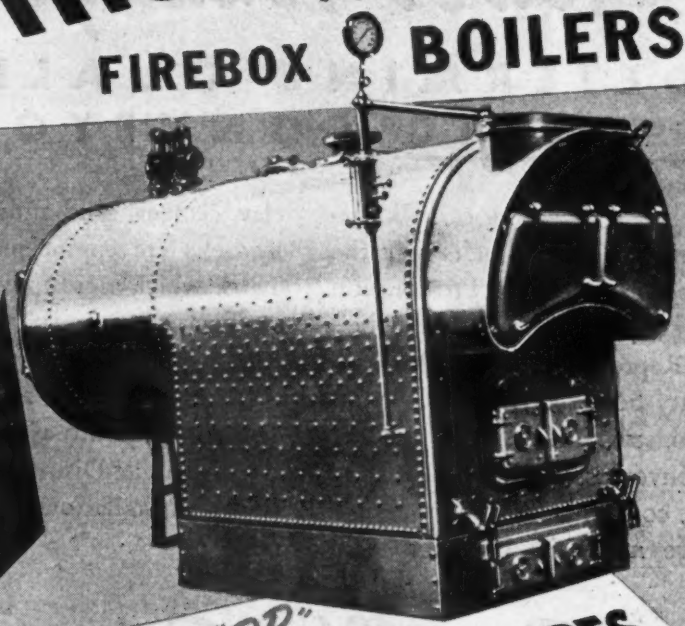
Johnson engineers and installation mechanics, located in principal cities, work with architects, consulting engineers, contractors and owners in solving temperature control problems. That is why the Johnson organization is called upon, time and again, by the same people to make technical surveys and recommendations without obligation. Investigate the fuel economy—the comfort and convenience—of Individual Room Control for all types of living and working spaces. Ask your heating and air conditioning engineer or contractor about Johnson—or call a Johnson engineer from a nearby branch office.

ARMY NAVY
DESIGN
MANUFACTURE
INSTALLATION
SERVICE

JOHNSON
SERVICE COMPANY
MILWAUKEE 2, WISCONSIN

DIRECT BRANCH OFFICES IN ALL PRINCIPAL CITIES

TITUSVILLE Portable FIREBOX BOILERS



in this NEW BULLETIN...

Series "RP" (RIVETED POWER) FOR HIGH PRESSURES USING ANY FUEL

...YOU GET THE INSIDE *Facts* ABOUT

NEW DEVELOPMENTS IN HIGH PRESSURE BOILERS

Free copy on request

Just off the press . . . it includes essential, technical information, specifications and the latest developments in boiler engineering to provide maximum efficiency, economy and dependability.

Division of

STRUTHERS WELLS CORPORATION

Plants at Titusville, Pa. and Warren, Pa.

TITUSVILLE IRON WORKS CO TITUSVILLE, PA.

Longer Service and Lower Tonnage Cost

DETERMINE QUALITY IN REPUBLIC CONVEYOR BELTS

The handling of bulk materials economically requires belts with the necessary strength and resistance to abrasion and other service conditions. Republic's Super Excelo Reprene and Record Maker-S are heavy duty belts, with rubber compounds and construction designed for long service on conveyors handling large size rock and ore, coal, coke and other heavy, highly abrasive materials. For sugar, salt, clay, cement, sand and aggregates, Republic belts are engineered for such service. Those which must convey materials at high temperatures are specially designed, too. Republic's technologists have taken each service under study, and have put the necessary quality into a belt for each. Consult your Republic Distributor on conveyor and elevator installations.

• • • •

Better Than Before

WE ARE PARTICIPANTS IN THE OWNERSHIP AND OPERATION OF NATIONAL SYNTHETIC RUBBER CORPORATION

REPUBLIC RUBBER

DIVISION

LEE RUBBER & TIRE CORPORATION

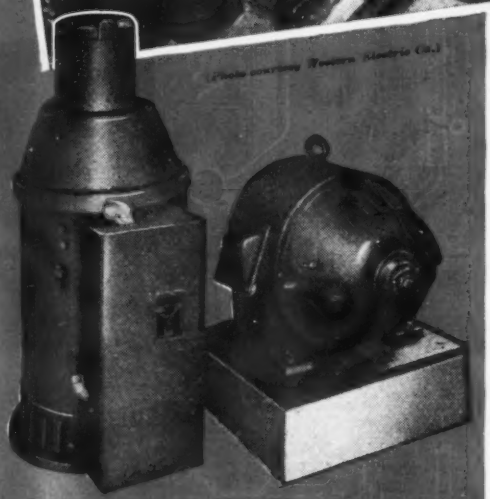
YOUNGSTOWN 1, OHIO

REPUBLIC INDUSTRIAL PRODUCTS
YOUNGSTOWN O

LEE DELUXE TIRES AND TUBES
CONSHOHOCKEN, PA.

START AND ACCELERATE *Smoothly* with RELIANCE V•S DRIVE!

Each of these wire-twisting machines is driven and controlled by its individual Reliance V•S Drive—for *smooth* starting and *smooth* acceleration.



V•S is an all-electric, adjustable-speed drive, operating from AC circuits, through which starting, stopping and speed changes are effectively controlled, automatic reversal provided at any desired point and tension properly maintained. The possibilities of Reliance V•S Drive in helping to speed production and cut costs are almost limitless. It will pay you to investigate.

Four rubber-covered conductors and the plastic center filler are twisted into "Spiral-4" cable for use on the fighting fronts by this battery of machines, at the Point Breeze Works of the Western Electric Company.

Here, as in many other applications, Reliance V•S Drive has provided the smoothness and flexibility of control which are vital to speed and quality of production. Low creeping speeds for adjustment virtually eliminate wastage, starting and acceleration are free from jerks or irregular motion and both quantity and quality of production are maintained at a high level.

For complete information as to the possibilities of Reliance V•S Drive, call the nearest Reliance office, or write for Bulletin 311.

RELIANCE ELECTRIC & ENGINEERING CO.

1068 Ivanhoe Road • Cleveland, Ohio

Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit • Greenville (S. C.) • Houston
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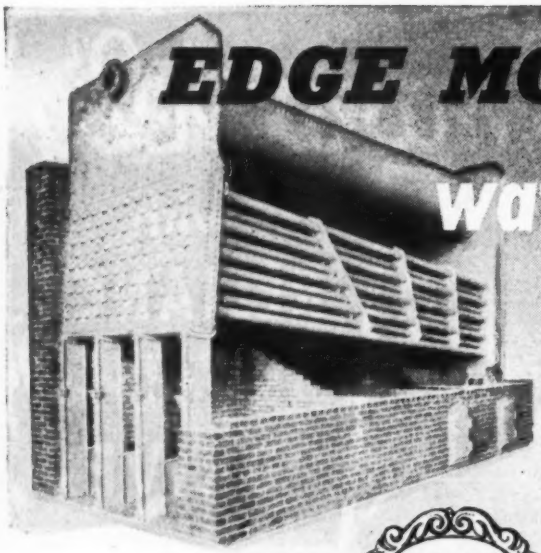
RELIANCE A·C D·C MOTORS

"Motor-Drive is More Than Power"

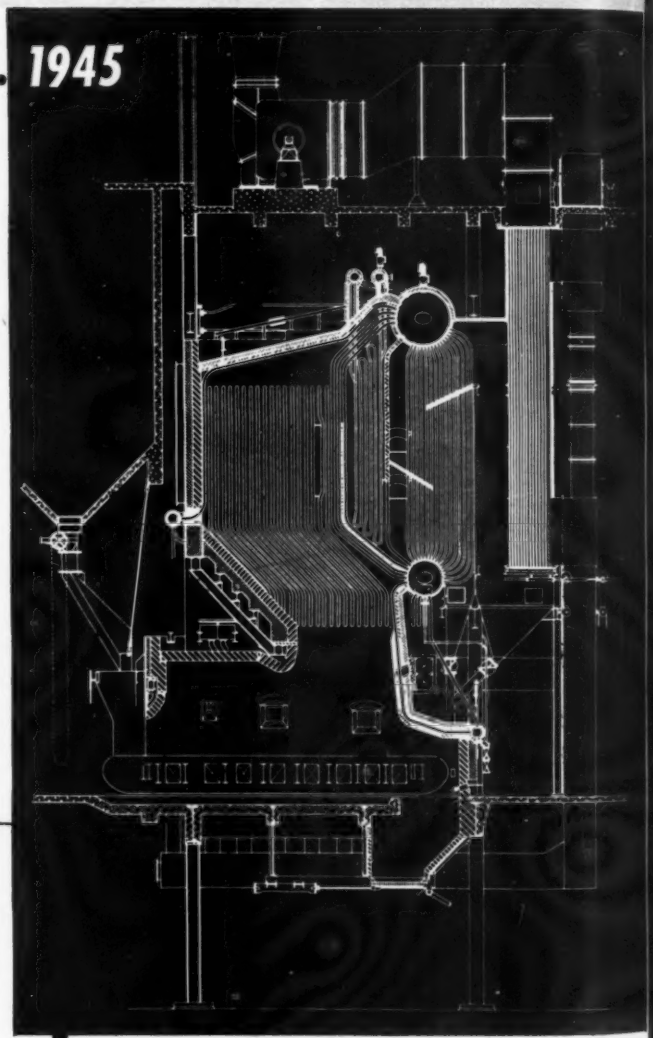
EDGE MOOR
water tube boilers



VINTAGE 1895 • THE FIRST EDGE MOOR WATER TUBE BOILER

An Edge Moor Catalog of 1902 states: "This boiler is still in active service, and demonstrates that our boilers were designed on sound principles, and only improvements in details were necessary to make them what they are today."

1895 1945



Edge Moor was established in 1868 and has been building steam generating units for nearly three-quarters of a century. Fifty years ago, in 1895, we began the manufacture of water tube boilers, and followed several years later with the first superheating steam boilers.

Edge Moor engineers have continued to contribute to the store of knowledge and experience gained in the building of steam generating equipment. Today, upwards of 5000 installations attest to the many advances in design, efficiency and standards of quality originated by Edge Moor.

Edge Moor boilers are designed for any required capacity and up to 900 lbs drum pressure. Complete steam generating units, auxiliary equipment and installation service are available—from Edge Moor.

Edge Moor 2-drum bent tube boiler with pendant convection superheater, vertical tubular air preheater, water cooled furnace, travelling grate stoker. Capacity, 75,000 lbs steam per hour; Drum Pressure, 450 psi; Degrees of Superheat, 300; Final Steam Temperature, 750° F.

STEAM GENERATING EQUIPMENT

EDGE MOOR IRON WORKS, INC.

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE AND WORKS: EDGE MOOR, DELAWARE

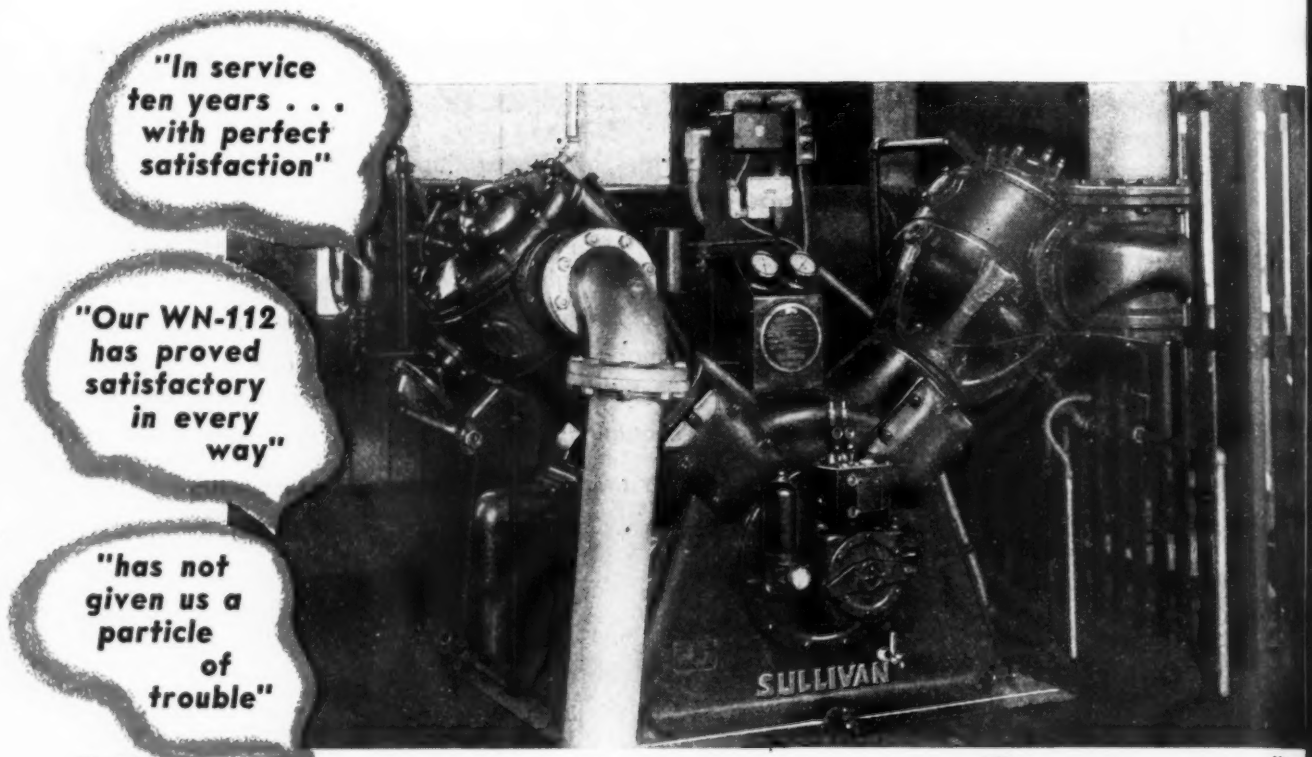
High-Temperature Merry-go-Round

Stainless steel blades are used in these high-speed, high-temperature steam turbines for a number of reasons. The blades must not corrode or pit under the action of super-heated steam while travelling at high speed and they must not "creep" under the combination of high temperature and centrifugal stresses.

There are many applications in industry where a tough heat-enduring metal like this means longer life, fewer shutdowns, and more economical operation. Have you tried stainless steel?

BUY UNITED STATES WAR BONDS AND STAMPS

Other interesting uses of stainless steel are described in ELECTROMET REVIEW published by ELECTRO METALLURGICAL COMPANY, the Unit of UNION CARBIDE and CARBON CORPORATION that produces alloys for making steel. If you are an executive, engineer, or designer you can be put on the mailing list for ELECTROMET REVIEW by sending your name on your business letterhead to ELECTRO METALLURGICAL COMPANY, Room 328, 30 East 42nd Street, New York 17, N.Y.

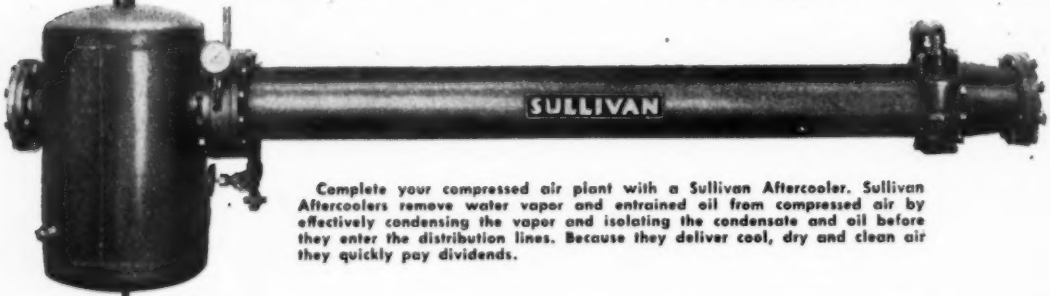

"In service ten years . . . with perfect satisfaction"
"Our WN-112 has proved satisfactory in every way"
"has not given us a particle of trouble"
SULLIVAN

"We're glad we selected Sullivan"

These are typical comments from manufacturers all over the country. Years from now they will still be glad they installed this Sullivan heavy-duty, two stage WN-112 air compressor because it will still be providing quiet, efficient, heavy-duty service twenty-four hours a day with a minimum amount of attention.

The superior design of Series 100 air compressors, a design that was pioneered by Sullivan more than ten years ago, eliminates the need for adjustments characteristic of ordinary compressors. The precision cross-head and connecting rod bearings never require adjustment. Full force-feed lubrication is automatically protected against possible oil pressure failure. The patented Sullivan "Dual-Cushion" valve is free-acting, coming to rest smoothly and quietly at the top of the lift . . . *and on its seat.* There's no pounding action to shorten valve life or cause valve noise. When compressor wear eventually occurs, "new machine efficiency" can be easily, quickly and economically regained by replacing cylinder and cross-head liners.

Sullivan Series 100 air compressors are offered in single or twin units with piston-displacement capacities from 378 to 3656 C.F.M., at pressures up to 125 p.s.i. Ask your nearby Sullivan representative for a copy of Bulletin A-52 which contains full details, or write direct. **SULLIVAN MACHINERY COMPANY, Michigan City, Indiana. In Canada: Canadian Sullivan Machinery Co., Ltd., Dundas, Ont.**



Complete your compressed air plant with a Sullivan Aftercooler. Sullivan Aftercoolers remove water vapor and entrained oil from compressed air by effectively condensing the vapor and isolating the condensate and oil before they enter the distribution lines. Because they deliver cool, dry and clean air they quickly pay dividends.

SULLIVAN

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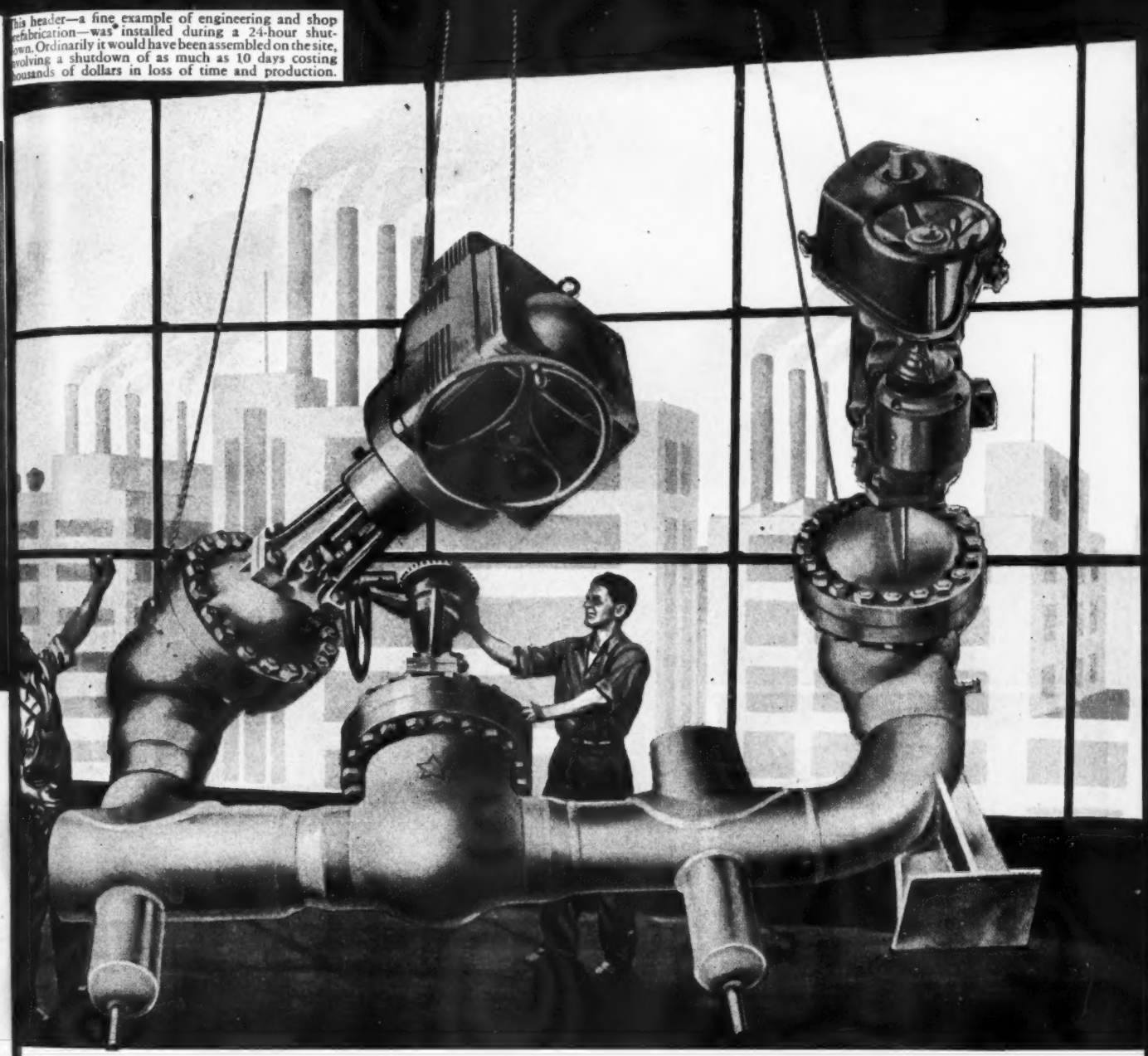
PRODUCTS

Stationary and Portable Air Compressors for ¼ to 3,000 H.P., Pneumatic Casting Grips, for dation Breakers, Portable Hoists, Rock Drills.



This header—a fine example of engineering and shop prefabrication—was installed during a 24-hour shutdown. Ordinarily it would have been assembled on the site, involving a shutdown of as much as 10 days costing thousands of dollars in loss of time and production.

PUTTING *POWER* IN ITS PLACE . . .

Blaw-Knox Prefabricated Piping, Functional Hangers and Vibration Eliminators are in use where multiplied production for the war effort demands unremitting stability of power piping lines and speed of installation.

Power Piping is but one of many Blaw-Knox products. Blaw-Knox is intimately identified with quality equipment and engineering "know how" in the iron, steel and non-ferrous industries, in equipment for railroads, public utilities, the electronic and construction industries and industry in general. It has achieved leadership in engineering, designing and producing plants and equipment for the chemical and process industries.

As Blaw-Knox can serve you with prefabricated piping, so it can serve you—with products and engineering—in all the fields in which it is active. Perhaps we can help you with your present or future activities. We will be glad to discuss it with you.

BLAW-KNOX COMPANY

A PACEMAKER FOR AMERICAN INITIATIVE AND INGENUITY

2029 FARMERS BANK BLDG. PITTSBURGH, PA.

Six Blaw-Knox Plants have been awarded the Army-Navy "E" for war-production excellence

LEWIS FOUNDRY & MACHINE DIVISION, Rolls and Rolling Mill Machinery

POWER PIPING DIVISION, Prefabricated Piping Systems

SPECIAL ORDNANCE DIVISION, Bofors Anti-Aircraft Gun Mounts and Mechanisms

BLAW-KNOX DIVISION, Chemical & Process Plants & Equipment, Construction Equipment, Steel Plant Equipment, Radio & Transmission Towers . . . General Industrial Products

CHEMICAL PLANTS DIVISION, Chemical and Process Plants from laboratory to production

PITTSBURGH ROLLS DIVISION, Rolls for Steel and Non-Ferrous Rolling Mills

UNION STEEL CASTINGS DIVISION, Steel and Alloy Castings

NATIONAL ALLOY STEEL DIVISION, Heat and Corrosion-Resistant Alloy Castings

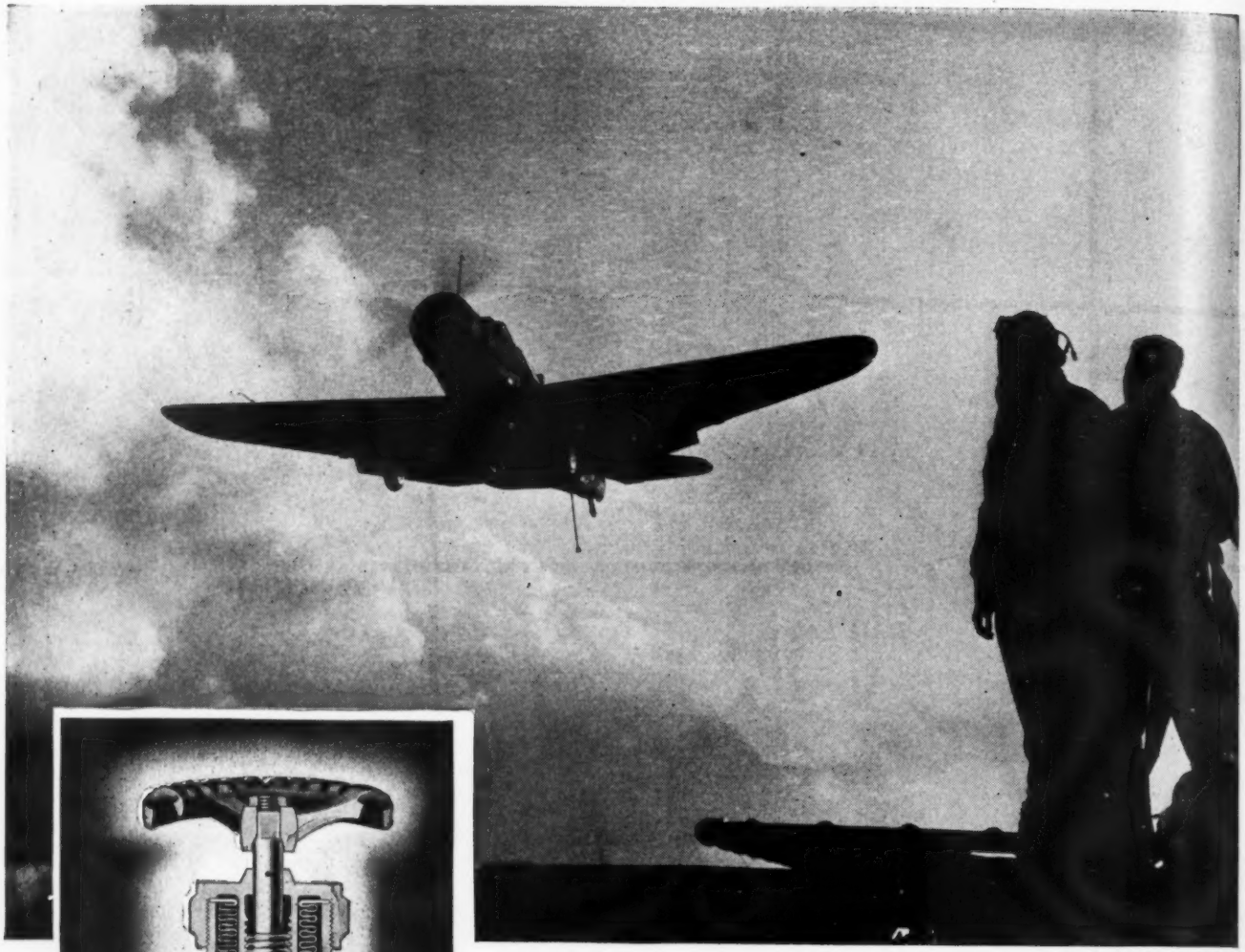
MARTINS FERRY DIVISION, Bofors Anti-Aircraft Gun Mounts

BLAW-KNOX SPRINKLER DIVISION, Automatic Sprinklers and Deluge Systems

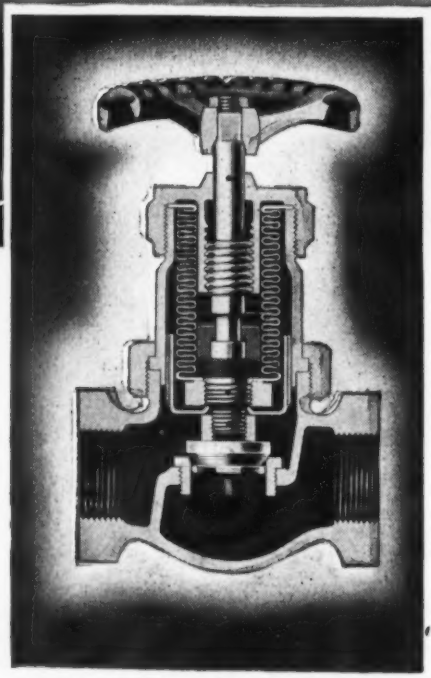
BUFLOVAK EQUIPMENT DIVISION, Food Processing Equipment, Evaporators, Dryers, Distillation and Solvent Recovery Equipment, etc.

A FEW VICTORY PRODUCTS

ANTI-AIRCRAFT GUN MOUNTS · POWDER PLANTS · PIPING FOR NAVAL VESSELS · SYNTHETIC RUBBER PLANTS · GUN SLIDES · 14" PROJECTILES · LANDING BARGES · ROCKETS · CAST ARMOR FOR TANKS & NAVAL CONSTRUCTION · CHEMICAL PLANTS



Official U. S. Navy Photo



Sylphon Packless Valves come in the following sizes: 304-N, ½" to 2" for liquid pressures up to 150 lbs.; 1304, 2½" to 6" for liquid pressures up to 80 lbs. Screwed or flanged connections.

LESSON FOR MANAGEMENT

THAT FLYERS CAN LOOK DOWN upon their carrier with its hundreds of thousands of gallons of high-octane gasoline and think of it as "a nice place to come home to," is due, among other things, to the extensive use which the U. S. Navy has made of Fulton Sylphon Packless Valves.

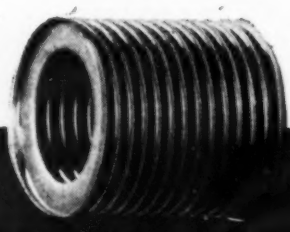
These valves eliminate the danger of tiny, hidden leaks which often develop through stem assemblies on conventional valves—prevent the escape of explosive vapors which might easily blow a carrier sky-high.

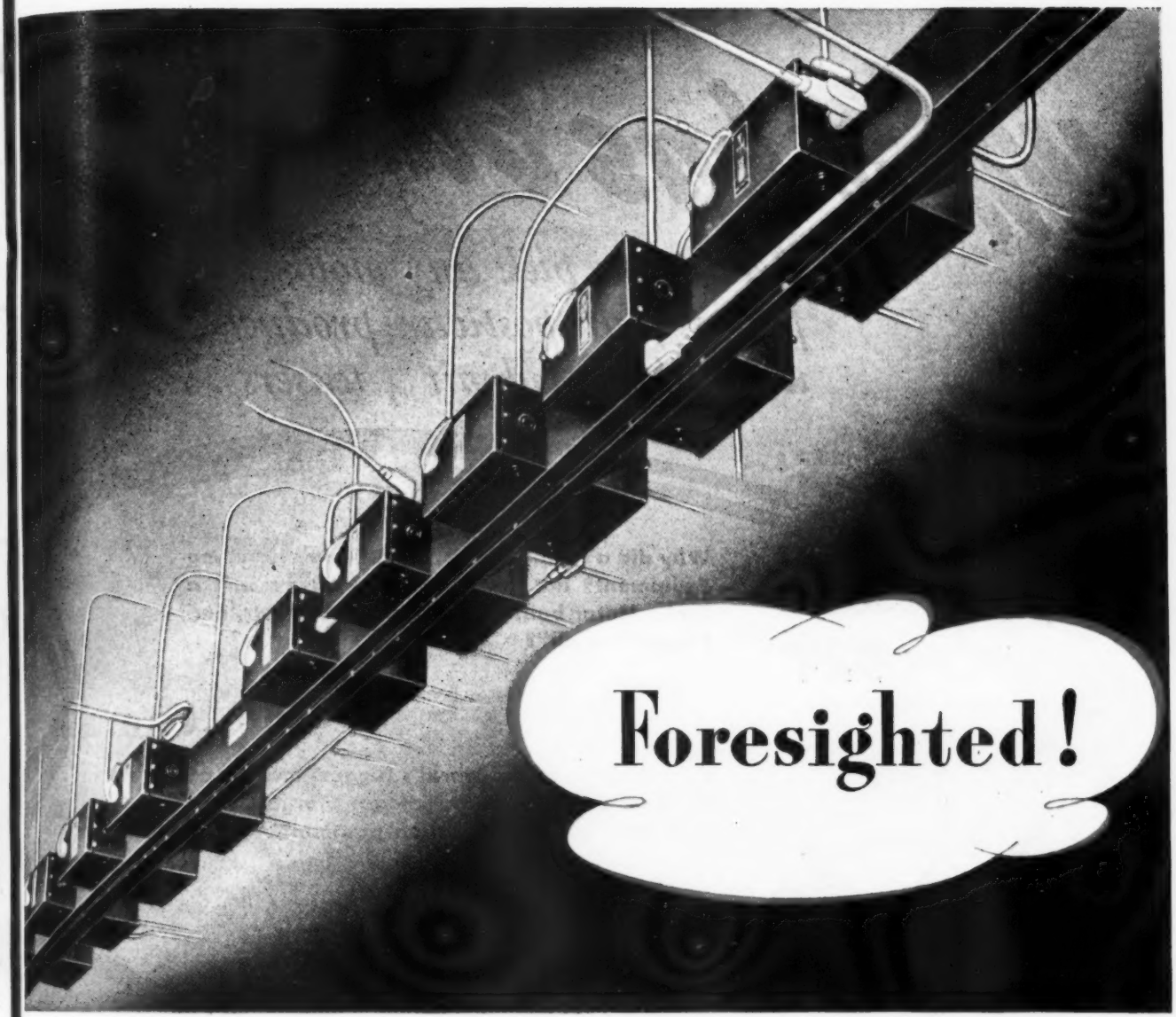
These same valves are available to industry . . . for use wherever explosive liquids are handled; in power plants to prevent steam loss; also in process piping where critical pressure or vacuum lines are employed.

Write for Bulletin SN-813. Gives full information . . . sizes, installation data, etc. Especially valuable to designers, engineers and builders.

NEW MOVIE, "The Story of a Bellows," is available to interested groups and organizations. 16-mm. and 35-mm. sound film.

FULTON SYLPHON





BULLDOG BUSTRIBUTION DUCT FOR "PLUG-IN" POWER AT ANY POINT

BullDog has been looking ahead for nearly half a century.

That is why industrial users expect from us one outstanding development after another in electrical distribution. That is why *proved* BullDog equipment will figure increasingly in the changeover plans of leading plants all over the country.

BullDog BUStribution Duct is the original "plug-in" system which gives you electrical power WHEREVER and WHENEVER you need it. Designed to stay modern, its pre-fabricated units can be re-assembled anywhere—new branch circuits added—feeder lines extended. It is 100% salvable, too—no fixed wiring to tear out.

It is not a day too soon to plan peacetime adjustments in your plant. Is your factory power system as *flexible* as your future plans may call for?

BUStribution Duct will take care of your wartime requirements as well as future ones. It will pay you to investigate. Write for illustrated bulletins or consult BullDog field engineers.

BUY WAR BONDS

BULLDOG

ELECTRIC PRODUCTS COMPANY

SALVAGE PAPER

BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN. In Canada: BullDog Electric Products, Ltd., Toronto. Field Engineering Offices in All Principal Cities.

Also Manufacturers of

Vacu-Break Safety Switches—SafToFuse Panelboards—Switchboards—Circuit Master Breakers — BUStribution DUCT, for "plug-in" power—Industrial Trol-E-Duct, for movable "loads."

What has Star got?

Before you pick any motor to power your postwar product we'd like to submit 3 teasers . . .

(". . . and I know 'em all!")

Why did a famous maker of Materials Handling Equipment* not long ago say — "There isn't a Brake Motor built that can touch that Star, and I know 'em all"?

(". . . you like 'em tough")

Why did one of the world's biggest makers of Machine Tools* recently choose Star to work with on a tough application problem?

(". . . laying it in your lap")

Why did a noted Dairy Machinery company* pick Star to develop a unique small Generator for their new machine?

*(*Name on request)*

We needn't tell you that buyers like these three are motor-wise, and hard-boiled in their determination to obtain the most satisfactory solution to powering their products. . . .

And we needn't tell you that we have engineering brains second to none, or that we have excellent production facilities. Without them, we could not get to first base. . . .

What, then, is the "something extra on the ball" we *must* have to lead such concerns to choose to work with Star on their new products?

You'll find it's Star's approach to a motor problem – a willingness to give your job "top billing". There's no stop-watch on the brains applied to your problem – and there are not so many problems that we can't apply our best brains to all.

That's why you, too, will choose wisely by making Star your postwar "Motor Department". Our designing facilities can be placed at your command NOW, to solve any problems not covered by standard Star Motors, from ⅛ to 200 HP, some of which are available for early delivery. Star Electric Motor Co., 200 Bloomfield Ave., Bloomfield, N. J.

STAR MOTORS

POWER PACKAGED AS YOU NEED IT

Pre-fabrication brings to piping the benefits of factory methods and factory equipment. Pre-fabricated piping production is planned by men of long experience in the practical possibilities and limitations of piping. It is prepared in plants equipped with modern machinery and staffed by highly skilled organizations, including pressure welders whose work can be insured. This provides the exact control of procedure and the careful maintenance of quality that are characteristic of the best factory production.

Pre-fabricated piping is delivered to the job in a series of sub-assemblies ready to erect. All difficult operations have been performed . . . the sub-assemblies are commercially practical, correctly aligned, heat treated and stress relieved where necessary, thoroughly cleaned, shop tested and inspected. Piping pre-fabricated by a qualified fabricator is better piping . . . it saves money, time and trouble.

THE PIPE FABRICATION INSTITUTE

P.F.I. THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING PITTSBURGH, PA.

G-9

Here's GOOD HEALTH for boilers

For curved tubes a short-bodied 1300 series motor is used with universal joint between motor and Quick Repair head and a short length of hose at the rear to give flexibility.

Write today for the Elliott boiler tube cleaner bulletin. If you have an unusually tricky or difficult tube cleaning problem, consult with the nearest Elliott specialist. We will put you in touch.

The 1300 series motor connected to Type PN cutter head for 3" straight tubes

Cleaner for 3½" curved tubes, 1300 series motor and Type H2 head with universal coupling, short length of hose at rear of motor.

1300 series cleaner for 3" curved tubes with universal joint and drill, short length of hose connected to rear of motor.

1300 series motor equipped with vibrator head for use in removing scale from the outside of fire tubes.

Y-241

Elliott 1300 series tube cleaners are the speedy remedy for that tired feeling in scaled up boilers.

They have *power*—plenty of it, to drive cutter heads in a smashing attack on the toughest scale, at all the speed required to get a complete cleaning job in a *single pass* through each tube. No need to run the motor while the cleaner is being returned through the tube—simply haul it back and get going on the next tube without delay.

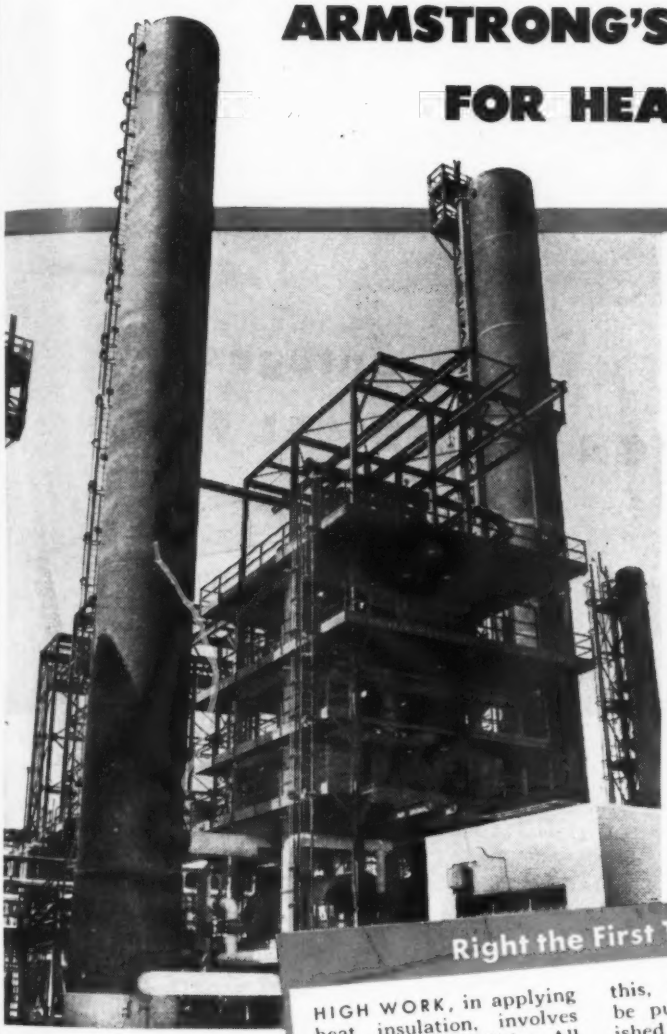
Elliott 1300 series cleaners have everything that years of veteran experience can supply to make the tube cleaning job easier, faster, more thorough.

Avoid that "tired feeling" in your boiler room personnel, too. Tube cleaning is a chore—but its unpleasant features can be greatly reduced. These Elliott 1300 series cleaners are proving it every day.

ELLIOTT COMPANY
TUBE CLEANER DEPT., SPRINGFIELD, O.
District Offices in Principal Cities
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.

ELLIOTT 1300 SERIES TUBE CLEANERS

You can turn over difficult jobs with confidence to ARMSTRONG'S CONTRACT SERVICE FOR HEAT INSULATION

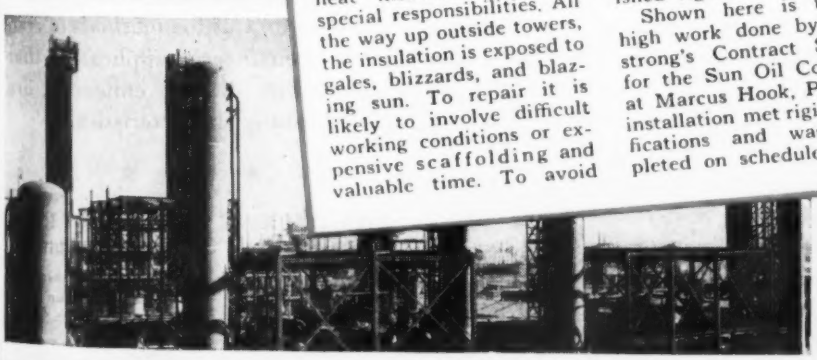


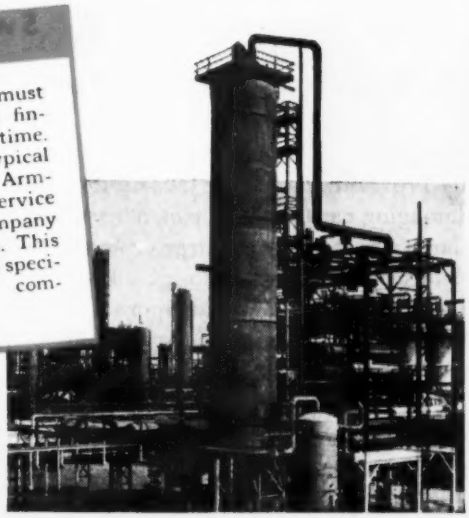
Resources and Experience that have solved the toughest kind of heat insulation problems are available when you use Armstrong's Contract Service. To make sure every job will be done right, and on time, Armstrong mobilizes its wide engineering know-how, provides materials of tested efficiency, and supplies skilled mechanics for the installation work. Over and above that, Armstrong takes full responsibility for every phase of the work—planning, supervision, materials, and workmanship. For complete information, write to Armstrong Cork Company, Building Materials Division, 7007 Concord Street, Lancaster, Penna.

Right the First Time

HIGH WORK, in applying heat insulation, involves special responsibilities. All the way up outside towers, the insulation is exposed to gales, blizzards, and blazing sun. To repair it is likely to involve difficult working conditions or expensive scaffolding and valuable time. To avoid this, the insulation must be put on right and finished right the first time.

Shown here is typical high work done by Armstrong's Contract Service for the Sun Oil Company at Marcus Hook, Pa. This installation met rigid specifications and was completed on schedule.



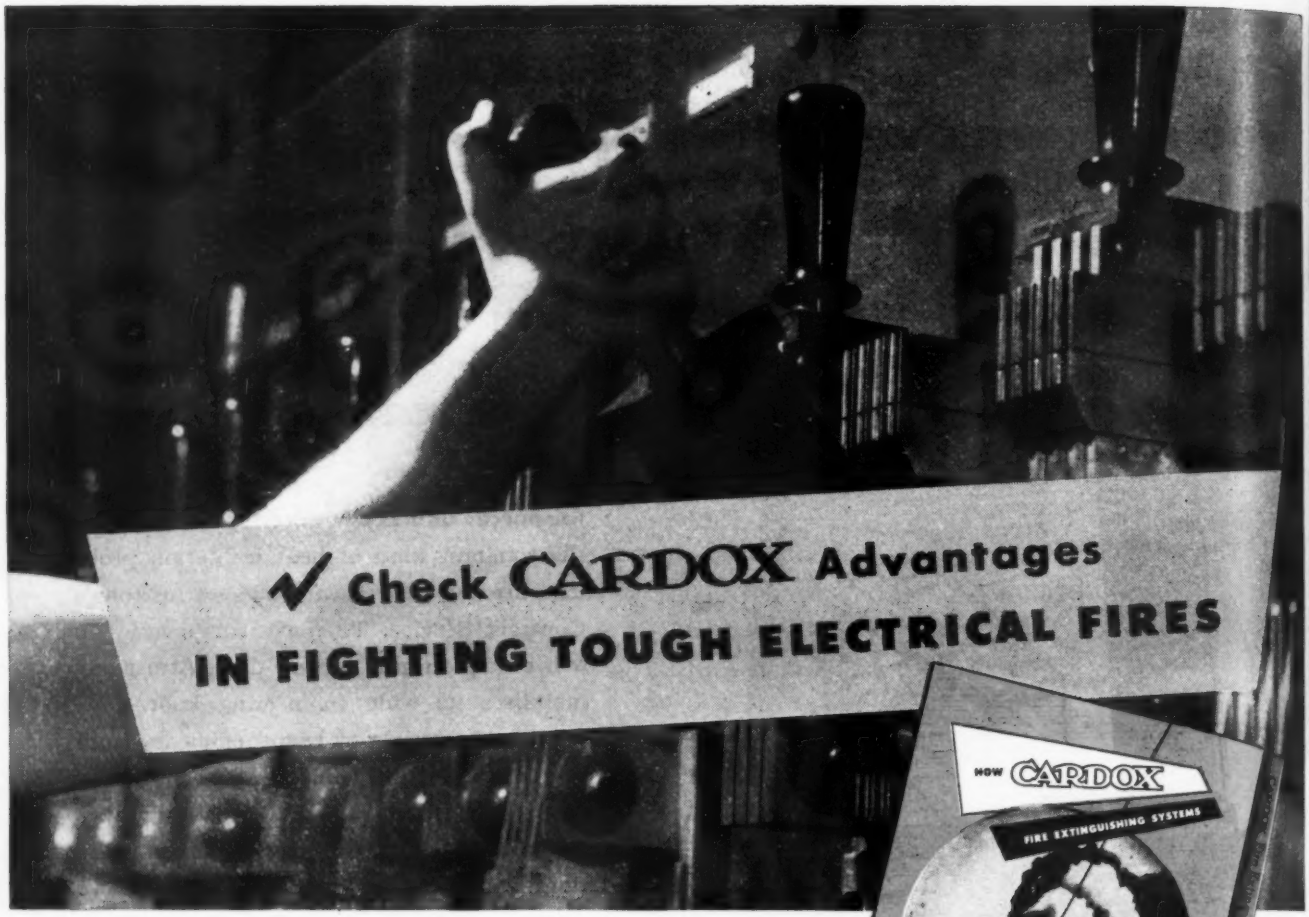


ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2600° Fahrenheit



In ✓ Circuit Breakers, ✓ Bus Bays, ✓ Distribution Vaults, ✓ Motors, ✓ Generators, ✓ Switchrooms, ✓ Transformers, ✓ Turbines

By providing *pounds* or *tons* of non-damaging carbon dioxide as needed, Cardox Systems tame large or small electrical fires in a flash . . . keep electrical equipment in operation where too little . . . too late . . . could spell disaster!

The Cardox method of fire extinguishment through mass application of Cardox CO_2 is unique. It makes the immediate extinguishment of even very large fires by this fast acting, non-damaging medium practical . . . with reserve capacity for new emergencies after complete extinguishment has been accomplished. How the Cardox System enhances the fire extinguishing performance of carbon dioxide is a subject of prime practical importance to executives concerned with better protection against tough, hard-to-fight electrical fires.

Write today for Bulletin 975, describing actual step-by-step extinguishment of test transformer fire involving 3000 gal. of transil oil . . . and data on Cardox methods of control and engineered application that give carbon dioxide enhanced fire extinguishing characteristics.

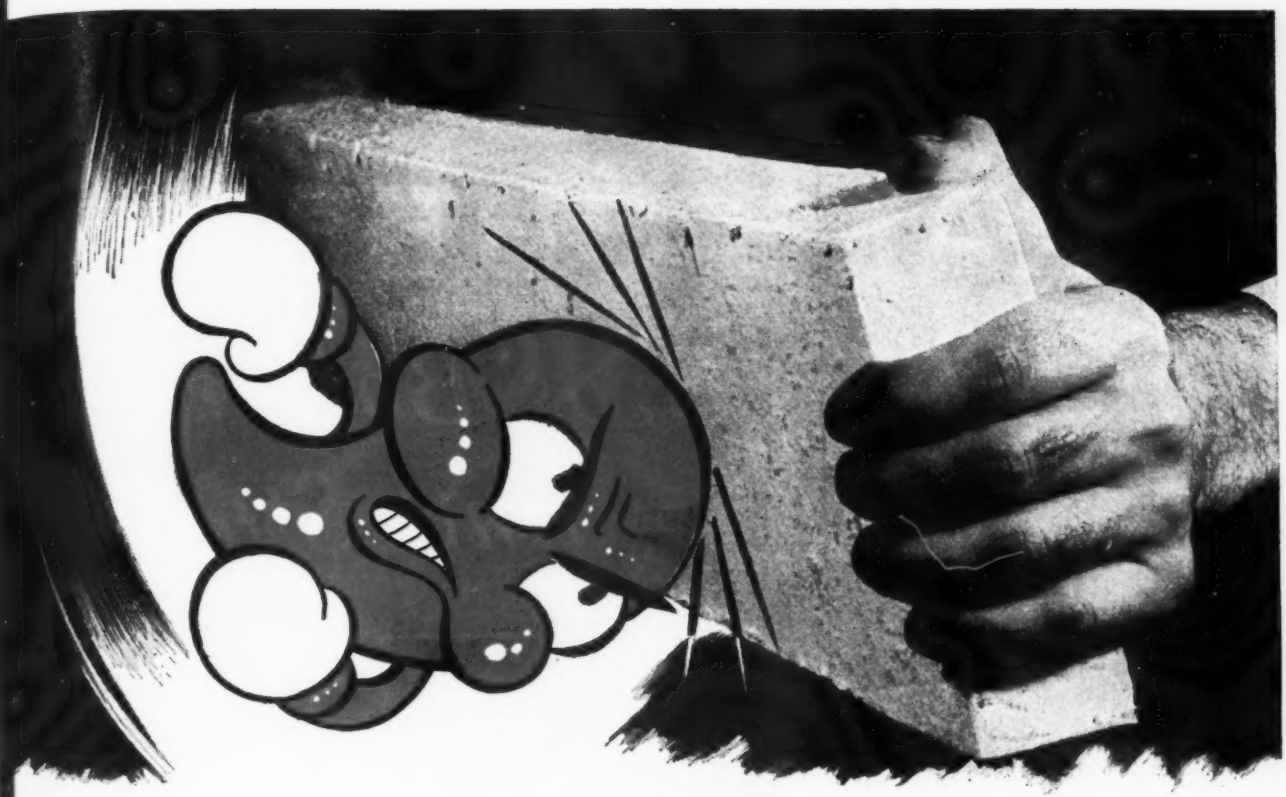
★ ★ ★

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in New York • Washington
Detroit • Cleveland • Pittsburgh • San Diego
San Francisco • Los Angeles • Seattle

CARDOX
CO_2 FIRE EXTINGUISHING SYSTEMS

Cardox CO_2 is supplied instantly in pounds or tons from a single storage unit containing 500 pounds to 125 tons at controlled low temperature of 0°F and 300 p.s.i.



Block those BTU's!

NATIONWIDE DISTRIBUTION—Warehouse stocks of the broad Carey line provide service regardless of job location.

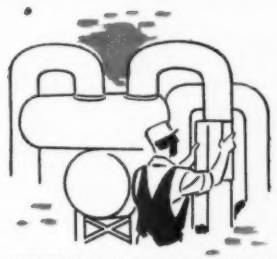
CAREY INSULATION ENGINEERING SERVICE makes available the knowledge and experience of leading authorities.

Tempt a BTU with improper or inadequate insulation and what happens? Energy vanishes into thin air . . . abnormal overloads and faulty operation may result . . . certainly a lot of precious fuel is wasted.

The remedy is *proper* insulation . . . *adequate* insulation.

For efficient high temperature operation, Carey makes a complete line of industrial insulations — blocks, sheets, cylindrical shapes and insulating cements. In addition, Carey engineers are ready to help you determine the *one best* insulation or combination for any specific requirement.

To utilize Carey's 50-odd years of heat insulation engineering experience just write—



TRAINED ERECTION AND SERVICE CREWS "make sure" the job is done right.

BROAD LINE FROM ONE SOURCE. No need to compromise with desired results. You get the right insulation for the job.

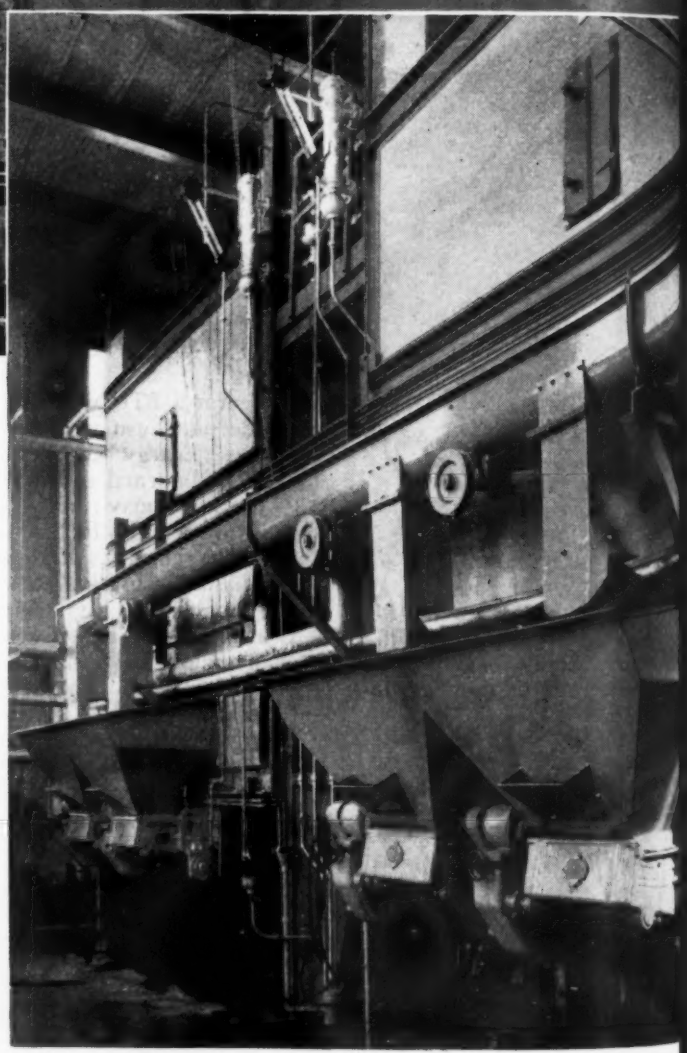
Carey

THE PHILIP CAREY MANUFACTURING CO.
LOCKLAND, CINCINNATI 15, OHIO

IN CANADA: THE PHILIP CAREY CO., LTD.
OFFICE AND FACTORY: LENNOXVILLE, P. Q.

Careyduct • Industrial Insulations • Rock Wool Insulation • Asbestos Shingles and Siding • Asphalt Shingles and Roofings
Built-up Roofing • Roof Coatings and Cements • Waterproofing Materials • Asphalt Tile Flooring • Pipeline Felt
Expansion Joint • Asbestos Wallboard and Sheathing • Corrugated Asbestos Roofing and Siding • Miami-Carey Bathroom Cabinets and Accessories

KRAFT CHEESE *installs Bros Boilers and Stokers*



● In its progressive program for the recovery and utilization of all the fractions of milk, Kraft is completing extensive alterations at its plant in Albany, Minn. To previously installed equipment with a 24 hour drying capacity of 500,000 pounds of sweet cream buttermilk, a spray dryer has been added with a capacity for drying 100,000 pounds of liquid whey per each 24 hours.

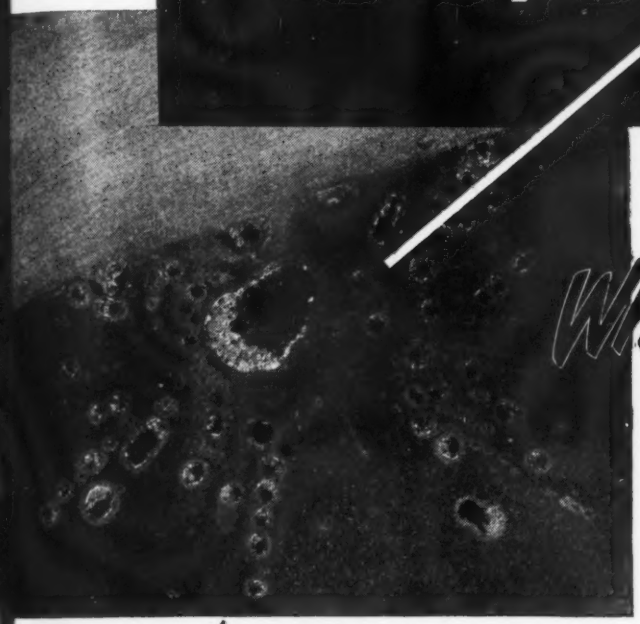
The steam requirements for processing such a tonnage are tremendous and called for the installation of two 337 H.P. Bros Boilers equipped with two double unit Model 24 Super-Spred Stokers.

If you have a steam generating problem tell it to Bros engineers. They will gladly consult with you and offer you helpful advice on your boiler needs. Wm. Bros Boiler & Mfg. Co., Minneapolis 14, Minnesota.

BROS

FABRICATORS OF STEEL • BOILERS • STOKERS • TANKS • ROAD EQUIPMENT

Source of $100,000,000 Damage



What's your share?

$100,000,000—that's just a conservative estimate of the annual losses caused by RUST.

Look at your records...see how much money *your* company has been penalized by this costly waste.

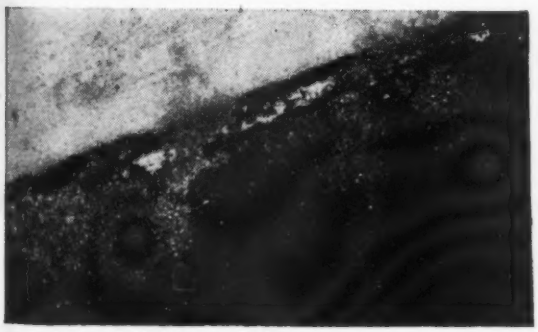
Adequate precautionary anti-rust measures *can* minimize or completely eliminate rust destruction.

Cities Service Rust Remover is an unexcelled first-step in plant-protection. This fast-acting liquid dissolves rust from iron or steel and removes tarnish from aluminum, brass, copper and other non-ferrous metals. Simple to apply, easy to remove.

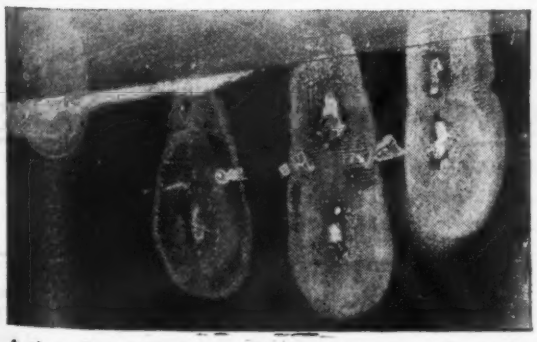
After cleaning, let your Cities Service engineer show you how to protect and preserve the cleaned metal surfaces with a special coating of Anti-Corrode.

Cities Service will be glad to study your plant operations and recommend a complete rust-prevention program without obligation on your part. You may avoid considerable trouble and expense. Call in a Cities Service expert today.

Rust caused by water from a leaking or "sweating" overhead pipe. Upper left portion was quickly cleaned with a cloth dampened with Cities Service Rust Remover.



Result of storage of raw steel stock subject to a humid atmosphere. Note that rusting has developed in a uniform layer. Upper half of plate was cleaned in 50 seconds with Cities Service Rust Remover.



Action of rust on sheet steel caused by finger marks in handling. Upper section has been cleaned with soft cloth dampened with Cities Service Rust Remover.

Mail this Coupon *Today*

CITIES SERVICE OILS
ONCE-ALWAYS

Cities Service Oil Company
Room P-347, 70 Pine Street,
New York 5, N. Y.

Gentlemen: Please send me further information on your Rust Prevention Program.

Name.....

Title.....

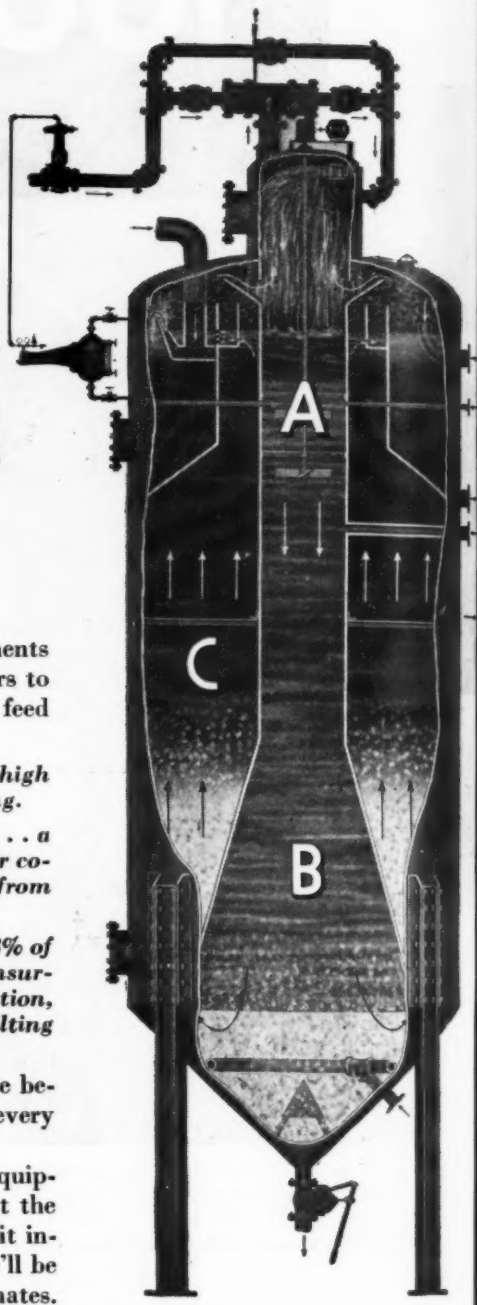
Company.....

Address.....

City..... State.....

GRAVER HOT PROCESS WATER SOFTENERS

MAINTAIN *correct velocity of flow* at these important points!



Here's another example of Graver engineering . . . of the refinements which have been built into Graver Hot Process Water Softeners to provide the utmost in efficiency . . . perfectly conditioned boiler feed water at low cost.

A. *In the first zone . . . where chemicals are added . . . a high rate of velocity is maintained, insuring thorough mixing.*

B. *In the second zone . . . where the floc begins to form . . . a gradual diminishing of velocity of flow permits proper coagulation of the finer particles and prevents the floc from breaking up.*

C. *In the third zone . . . where settling takes place . . . 93% of the total area of the tank is utilized as settling area insuring the low velocity necessary for effective settling action, thus producing a water low in turbidity with a resulting increase in the length of filter runs.*

This controlled velocity of flow is important. It's the difference between economical and costly operation. And it's a feature of every Graver Hot Process Water Softener.

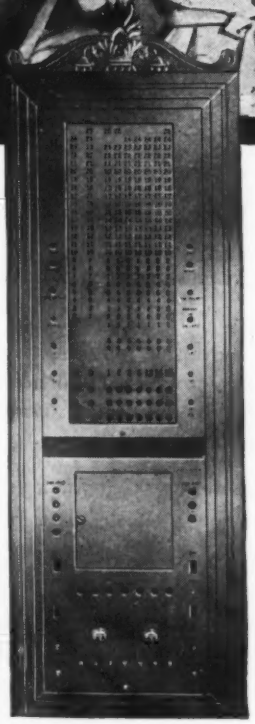
Graver designs and builds all types of water conditioning equipment for every industrial need . . . each one tailor-made to fit the requirements of its individual job. Whatever your problem, if it involves the scientific conditioning of water, consult Graver. We'll be glad to make unbiased recommendations and submit cost estimates.

GRAVER
WATER CONDITIONING EQUIPMENT

Process Equipment Division of
GRAVER TANK & MFG. CO., INC.
4809-25 Tod Ave., East Chicago, Indiana
NEW YORK CHICAGO CATASAUQUA, PA. TULSA, OKLA.
PHILADELPHIA PORT ARTHUR, TEX. LOS ANGELES, CAL.

Hot Process Water Softeners • Zeolite Water Softeners Water Filters • Taste and Odor Removal Filters • Iron Removal Filters • Oil Removal Filters • Chemical Mixing and Proportioning Equipment

OTIS *Dispatching* FOR IMPROVED ELEVATOR SERVICE



Dispatching Panel: Indicates position and direction of travel of the car and the location of waiting passengers.

Otis Elevator dispatching methods and equipment can help correct congested elevator traffic conditions.

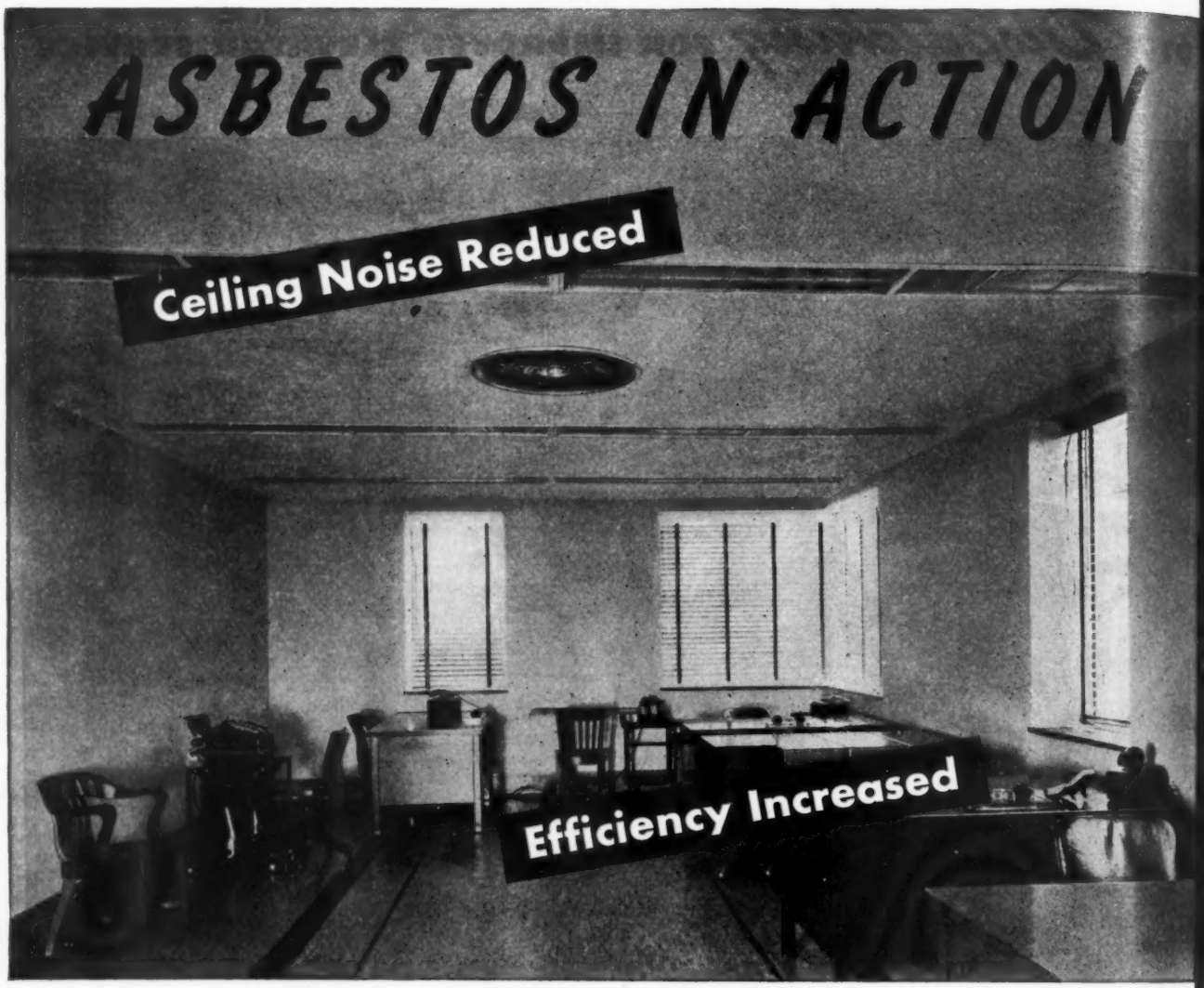
This scientific system of elevator operation and dispatching provides the highest quality and maximum quantity of service for a given number of elevators.

Otis dispatching is your assurance that every car is doing an equal share —that the flow of traffic is evenly distributed over the entire plant.

So, when it comes to new elevator installations or getting more work from your present equipment, investigate the possibilities offered by Otis dispatching equipment.

Your Otis representative is ready now to help you and your Architect plan the correct type of dispatching system best suited to your needs. For the finest in vertical transportation tomorrow, call your Otis representative TODAY.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES



Office acoustical problem solved by K&M Sprayed "Limpet" Asbestos

Three and a half years ago a "gun" sprayed a sound absorbing material on the ceiling of this office. Nerve-jangling noises were reduced by 70%. The efficiency of the entire office immediately increased.

This material was K&M Sprayed "Limpet" Asbestos, which, by its porosity, absorbs sound . . . by its diaphragmatic action, reduces it still further. This amazingly adaptable material goes on the most intricate architectural design as easily as plaster. It is ideal for acoustical treatment in laboratories, offices, engine-testing rooms —any place where working conditions can be improved by noise reduction.

Here are some of the advantages of K&M Sprayed "Limpet" Asbestos:

No cutting or fitting—completely covers, completely insulates—no seams, no joints, no holes. Easily applied—sticks tight to any clean surface regardless of shape or composition.

High noise reduction coefficient of .70 for a $\frac{3}{4}$" thickness.

Fire-resistant and heat-insulating—thermal conductivity .31 at 75° F.

Surface may be covered with as many as 10 coats of oil emulsion paint without seriously impairing efficiency.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

Dexter Has Saved Hours For Me . . . and Money For My Company . . .

says the Purchasing Agent

t takes all my time rounding up essential naterials for our products without having to worry about replacing worn valves in our lant. The new Dexter Valve Reseating outfit ve've installed has saved me that headache, or now one man can reseat a leaky valve ight on the steam, air, oil or water line in just few minutes. Our engineers say they perorm better than new ones after a Dexter reatment. It was a happy day, the day I ought a Dexter outfit.

Delivery in 60 days! Our non-military manufacturing facilities are catching up with our back orders, and we are now able to promise delivery in 60 days.

•

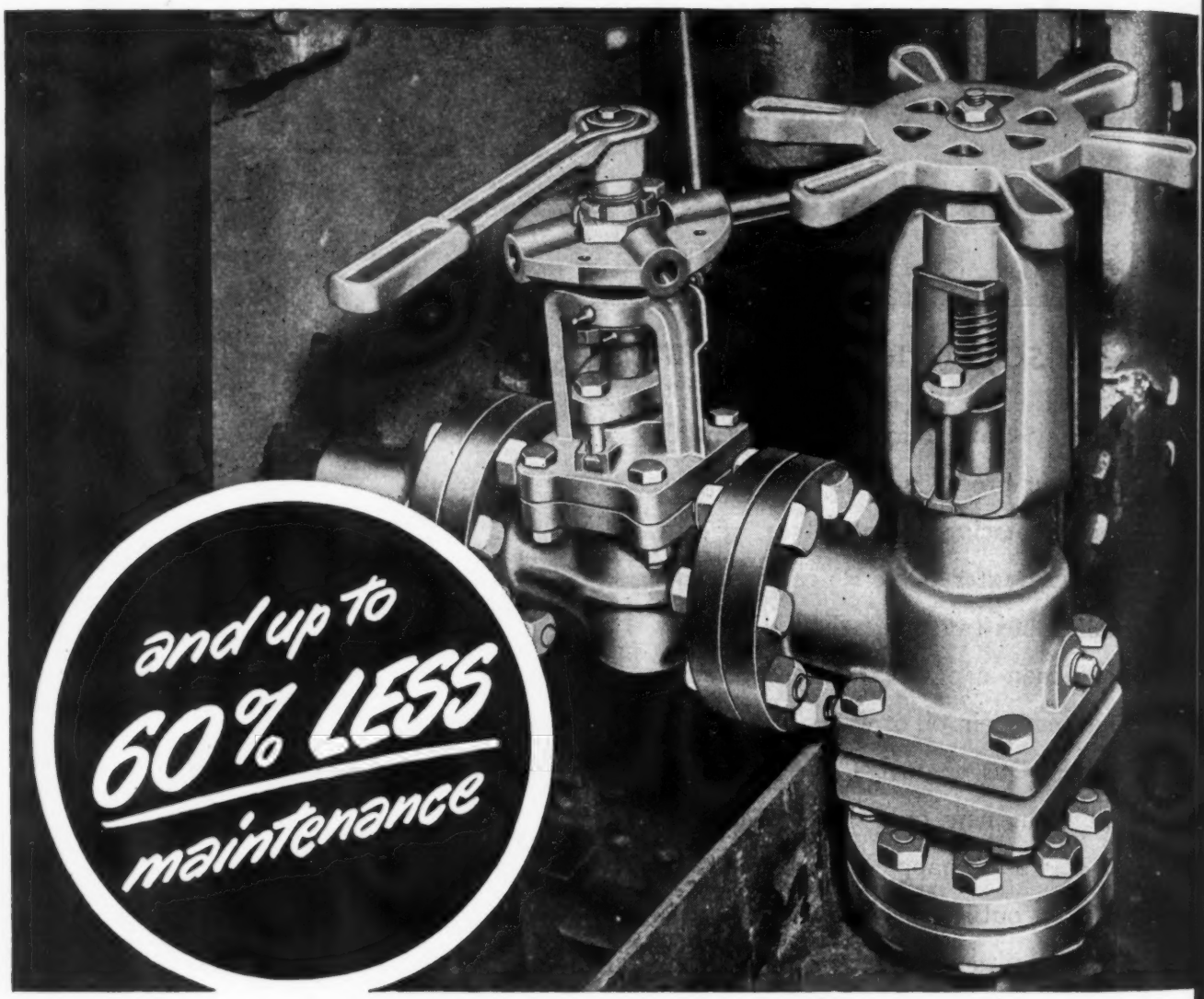
We'll help you . . . solve your leaky valve problems, if you'll just write us full data including make of valve, size, type and material, use and pressure. No obligation. 26

DEXTER VALVE RESEATING MACHINES AND CUTTERS

FOR GLOBE, GATE AND PUMP VALVES

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

Built to Outlast the Boiler...



... with Hovalco-Homestead Blow-Off Valves

Reports of HOVALCO-HOMESTEAD COMBINATION BOILER BLOW-OFF VALVES with records of 25 to 30 years continuous service are not uncommon. Their long life, and *up to 60% lower maintenance cost,* are due to advanced valve design and method of operation which limit practically all service wear to the special, high-silicon, monel seat and disc of the Hovalco Angle Valve. And this seat and disc, being *reversible,* need only be *turned over,* when wear occurs, to provide *new* seating surfaces and a good-as-new valve for another long, trouble-free period of service.

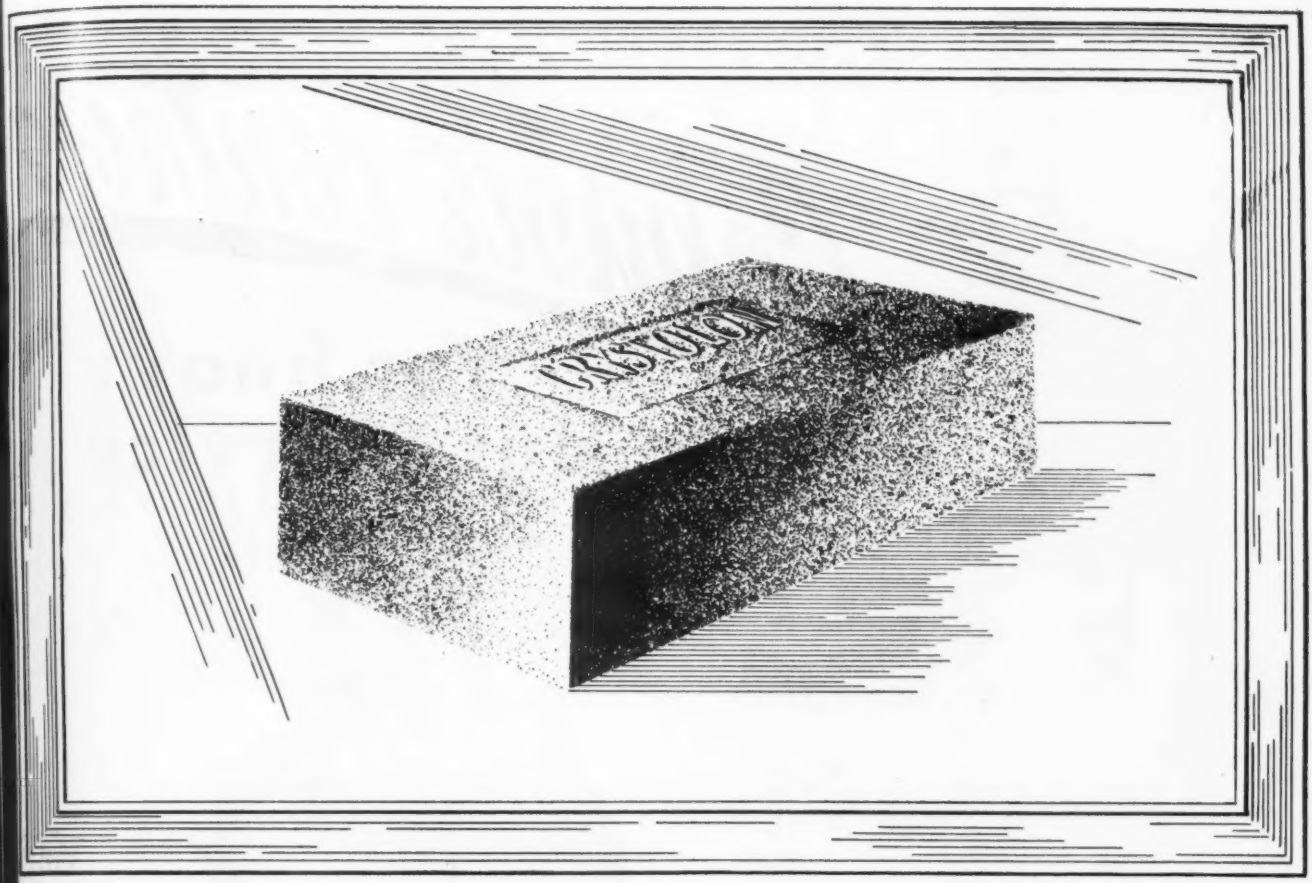
HOVALCO-HOMESTEAD COMBINATION BOILER BLOW-OFF VALVES, including either Lever-Seald or Cam-Seald, Quarter-Turn Plug Valves, meet all state laws and the A.S.M.E. Boiler Code. They can be furnished in 1½", 2", and 2½" sizes, for pressures up to 600 lbs.

For detailed information write for Valve Reference Book No. 38.

"M" Pennant with three additional gold stars —Maritime's highest production award to our men and women making Valves for the Victory Fleet.

HOMESTEAD VALVE MFG. CO.

P. O. BOX NO. 210 CORAOPOLIS, PENNSYLVANIA



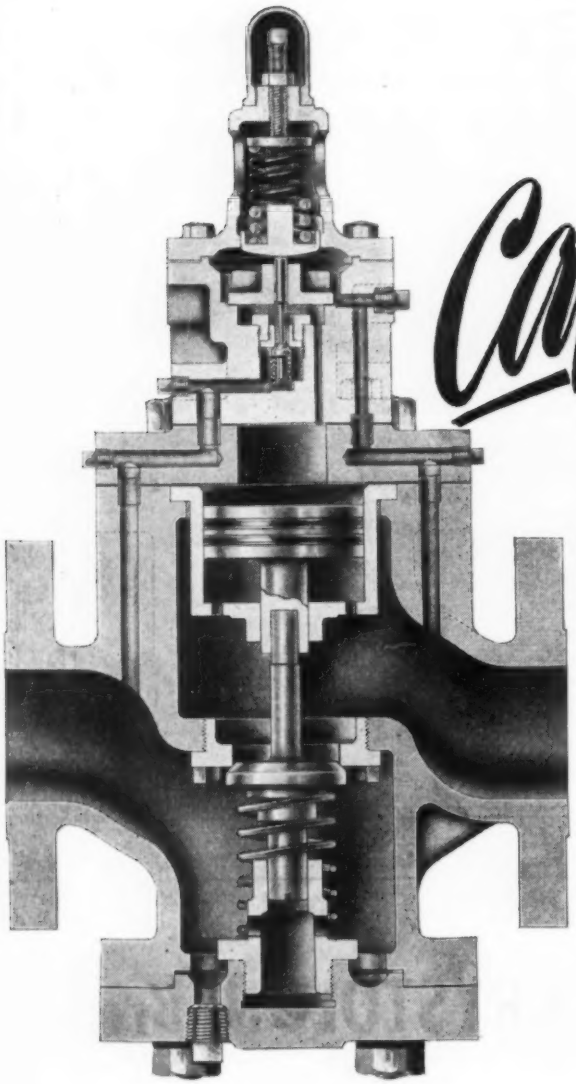
Portrait of a Successful Product: CRYSTOLON Brick

The success of CRYSTOLON Brick has been firmly established over a period of many years during which these highly refractory brick have given long, trouble-free service in stoker-fired boiler furnaces — as well as in water gas generators and in the combustion chambers of high temperature furnaces. Densely made of silicon carbide with a minimum of refractory bond, CRYSTOLON Brick have great resistance to abrasion, to spalling and to the chemical and physical action of molten slag. Clinkers may adhere to these brick to a very limited degree, but they are easily removed leaving the surface of the brick clean and unaffected for further service.

NORTON COMPANY - Worcester 6, Mass.

Norton Longer Lasting Refractories

Capable controls ...for heavy duty service



Left — Schade No. 230 Internal Pilot Operated Pressure Regulator.

Left—Mipco Class L, Series 100 Relief Valve, cast steel, iron or bronze.

Below — Mipco Class L, Series 53 Relief Valve, forged steel, flanged ends.

NOTE THE MECHANICAL FEATURES of the above valve and you will understand why it's a "capable control". Typical of the many other Associated controls, this Schade Pressure Reducing Valve has universal use in steam service. It is a compact self-contained unit especially suitable for high pressure, high temperature operations and where demands are intermittent. It is an example of the products Associated has available for every control requirement.

If you have control problems let Associated experience and engineering help you solve them. An engineer will gladly call at your request—no obligation, of course. Write today.

Above controls are products of

SCHADE VALVE MANUFACTURING CO. 2527 No. Bodine St. Philadelphia 33, Pa.

MARINE AND INDUSTRIAL PRODUCTS CO. 1526 Vine Street Philadelphia 2, Pa.

Associated Companies of

Associated Valve & Engineering Co.

510 N. Dearborn St. • Chicago 10, Ill.

ASSOCIATED VALVE & ENGINEERING CO. CONTROLS — CHICAGO • ILLINOIS

an associated company

TERRY

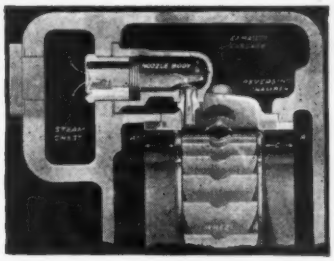
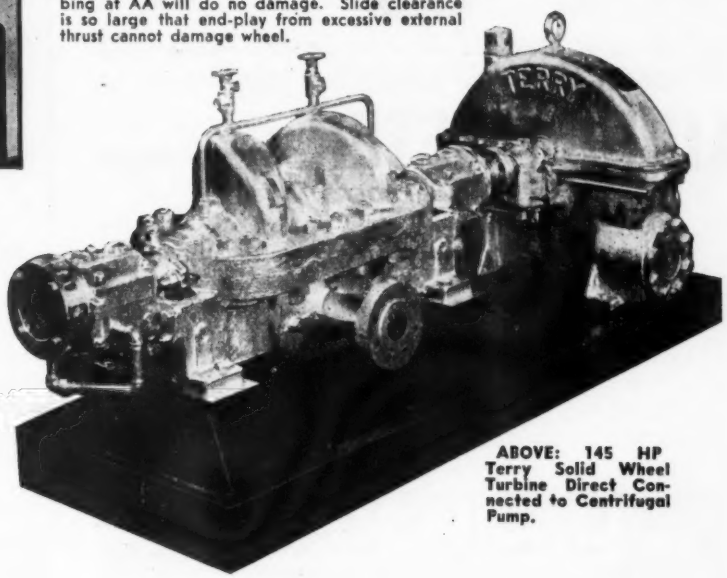
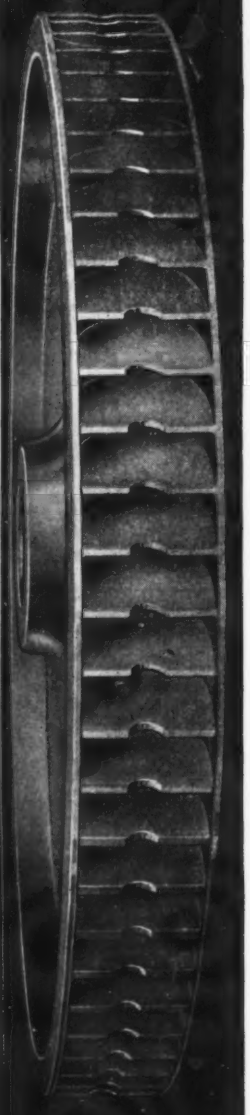


DIAGRAM SHOWING WHEEL CLEARANCES.

AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Slide clearance is so large that end-play from excessive external thrust cannot damage wheel.



ABOVE: 145 HP Terry Solid Wheel Turbine Direct Connected to Centrifugal Pump.



THESE LARGE WHEEL CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than 1/8 inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

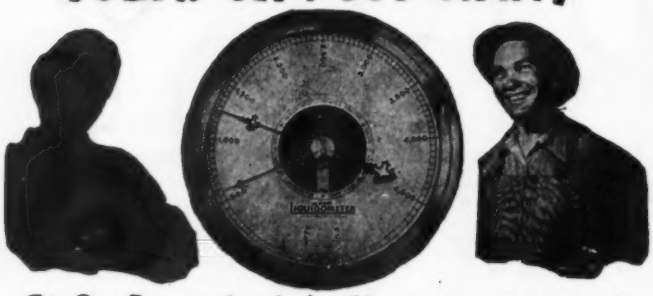
Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

T-1158

THE TERRY STEAM TURBINE COMPANY

TERRY SQUARE, HARTFORD, CONN.

TODAY OR POST-WAR!



It Is Important to Measure Valuable Stored Liquids Accurately With —

LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.
No pumps, valves, or auxiliary units needed to read them.
Models available for either remote or direct readings.
Accuracy unaffected by specific gravity of tank liquid.
Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details

THE LIQUIDOMETER CORP.
39-16 SKILLMAN AVE., LONG ISLAND CITY, L.I., N.Y.

"Industrial"

GEARS • RACKS • SPROCKETS

100.600 O.D.—11" Face—Steel Spur Gear, Precision Cut to Customers' Specifications.

"Industrial" Service is a combination of mass production and skill, backed by years of experience and specialization. You'll find it profitable to schedule your Gear, Rack and Sprocket orders through our organization.

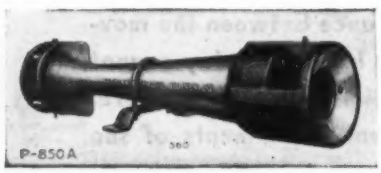
We're fully tooled for cutting Spur, Bevel, Mitre, Worm, Internal, Spiral, Angular and Helical Gears including Splines, Machine Racks, Roller and Silent Chain Sprockets and incident machining of castings and blanks.

Write for our 272 page Catalog and Engineering Handbook on your company stationery.

INDUSTRIAL GEAR MFG. CO.
4543 VAN BUREN STREET CHICAGO 24, ILLINOIS

"Airocool" GAS BURNERS

Widely used in industry . . . for Satisfactory Service



Airocool gas burners are of the venturi inspirating type, suitable for use where gas is supplied at higher pressures, for efficiently firing boilers and process furnaces.

They are made, as shown in the illustration, in sizes 4", 5", 6" and 8". Also, in a slightly different model for sizes 1" to 3".

All Airocool gas burners can be furnished with our patented flame stabilizing nozzle having an integral gas pilot and a refractory protected face. Airocool nozzles have long life and give a high turn down rate with "burning back" in the venturi.

Type "SA" Oil Burner Burns Gas House Tar and Residuums

NATIONAL AIROIL FUEL OIL - GAS BURNERS

Employing either gravity or pressure feed, with steam or air as an atomizing agent, the type SA is an economical and trouble free burner that has a wide range of applications. Steam consumption is very low. The burner requires only minimum maintenance and can be operated continuously without clogging or interruptions for cleaning.

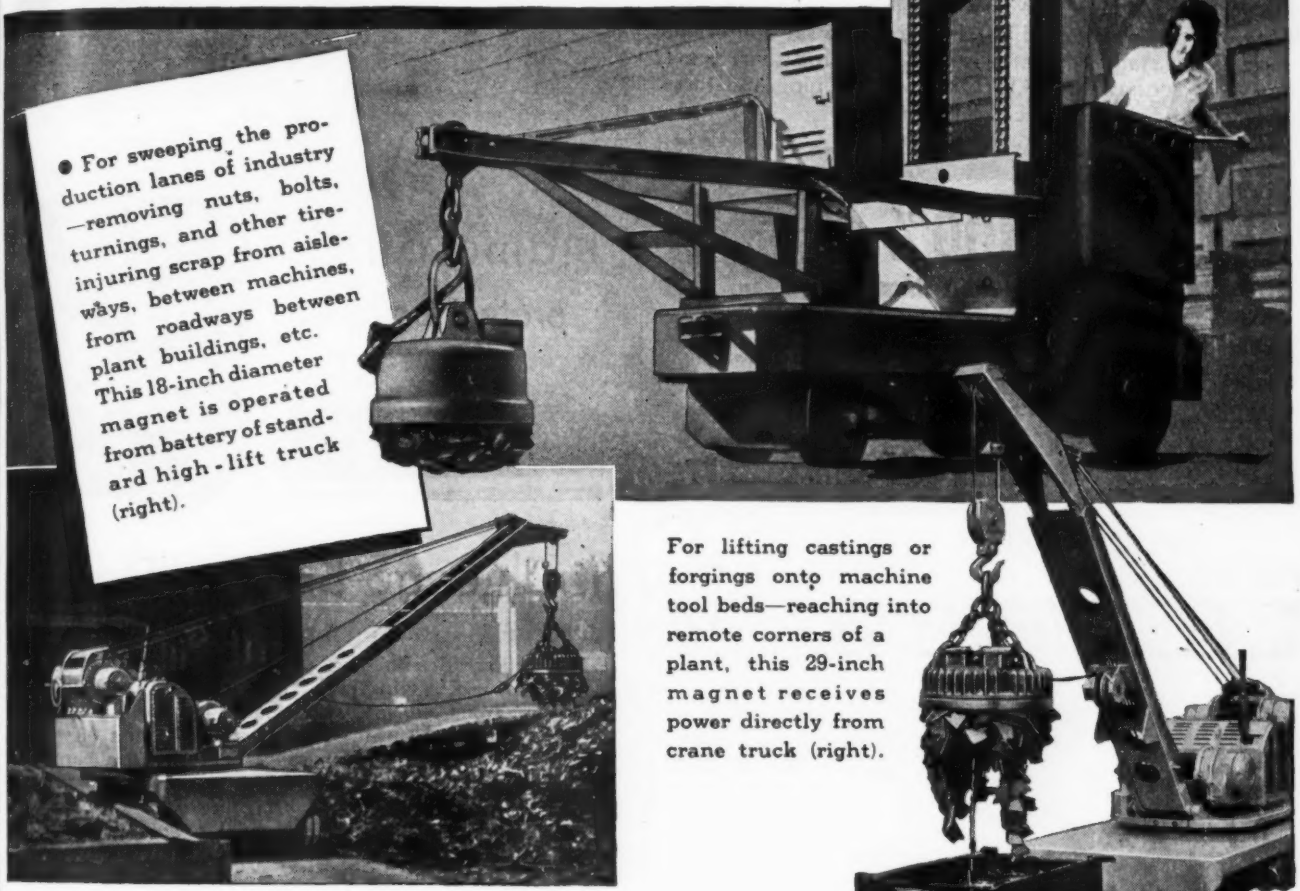
Cross Section of Type SA Oil Burner

Oil pressure and temperature requirements are low. This unit burns efficiently the cheapest grades of oil and tar.

NATIONAL AIROIL BURNER Company, Incorporated
1250 EAST SEDGLEY AVENUE PHILADELPHIA 34, PENNA.
OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS • EXPLOSION DOORS
ACCESS DOORS • AIR DOORS • BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

Getting Things Done Quickly...

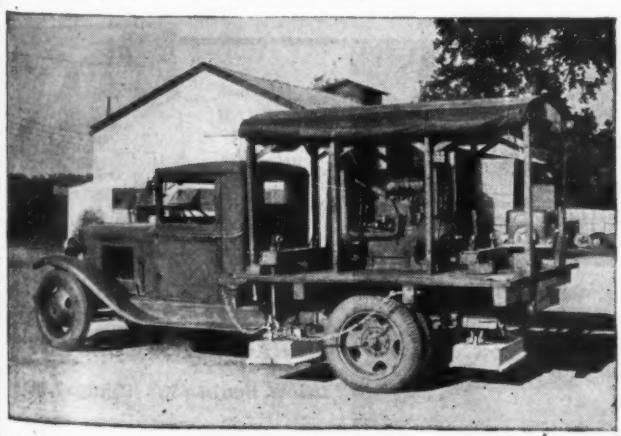
FLOOR-SWEEPING — MATERIAL-HANDLING — ROAD-SWEEPING OPERATIONS WITH EC&M MAGNETS



● For sweeping the production lanes of industry—removing nuts, bolts, turnings, and other tire-injuring scrap from aisle-ways, between machines, from roadways between plant buildings, etc. This 18-inch diameter magnet is operated from battery of standard high-lift truck (right).

Mobile units for loading scrap into gondola cars. Boom can be retracted and lowered to enter box cars for loading or unloading finished material. 36-volt power-generating unit on truck crane supplies direct current for this 29-inch diameter magnet. "Lift" and "Drop" push buttons are conveniently located adjacent to operator.

For lifting castings or forgings onto machine tool beds—reaching into remote corners of a plant, this 29-inch magnet receives power directly from crane truck (right).



Road-sweeping magnets for removing puncture-producing material from highways, parking lots around industrial plants, etc. Also efficient for clearing airfields of shrapnel and similar tire-damaging material. Gas-engine-generator set, on truck, supplies voltage for these 3 Type M magnets which cover 8-foot wide section of roadway.

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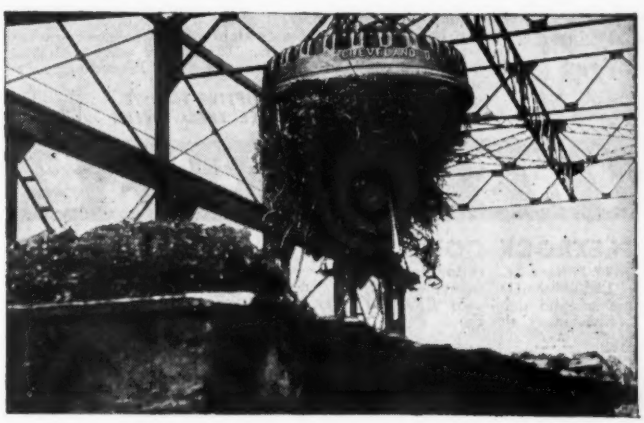

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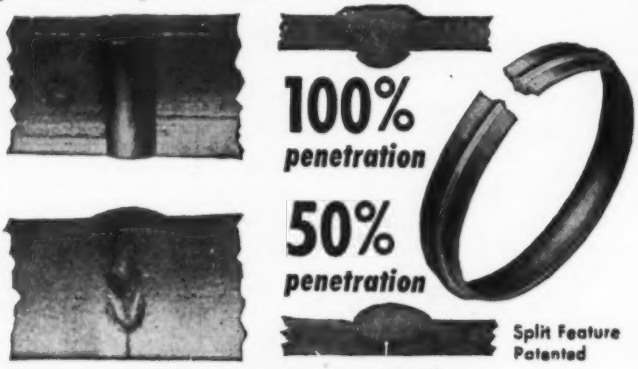

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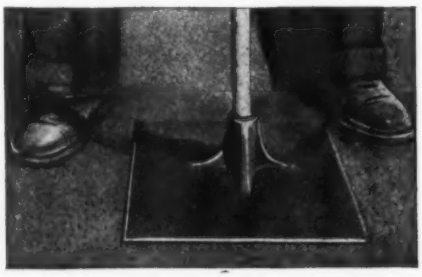

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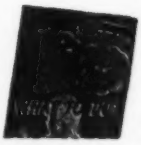

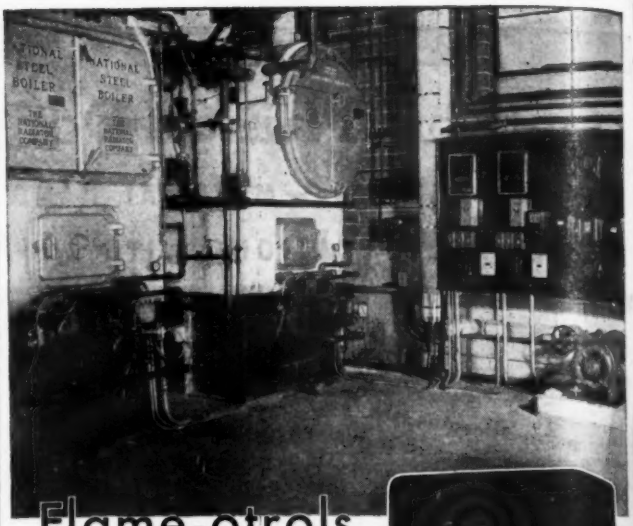

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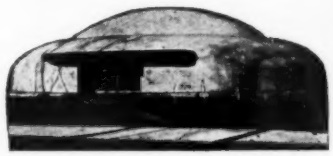

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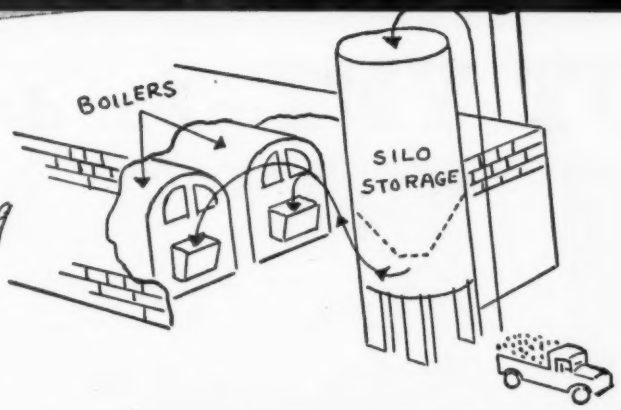

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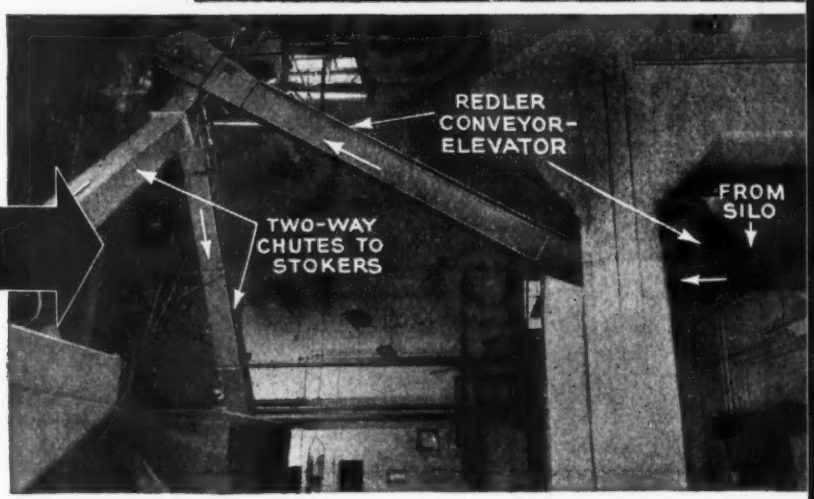

CLEAN INSIDE

Compact, out of the way, the REDLER Conveyor-Elevator automatically feeds coal to the two stoker hoppers. There's no chance for coal dust to reach the inside of the plant either, thanks to the completely sealed castings of the REDLER.

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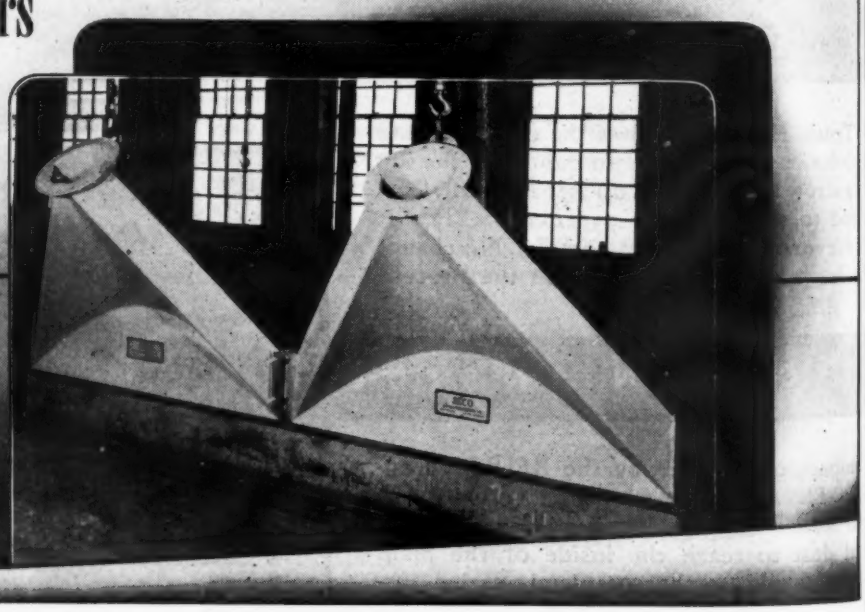

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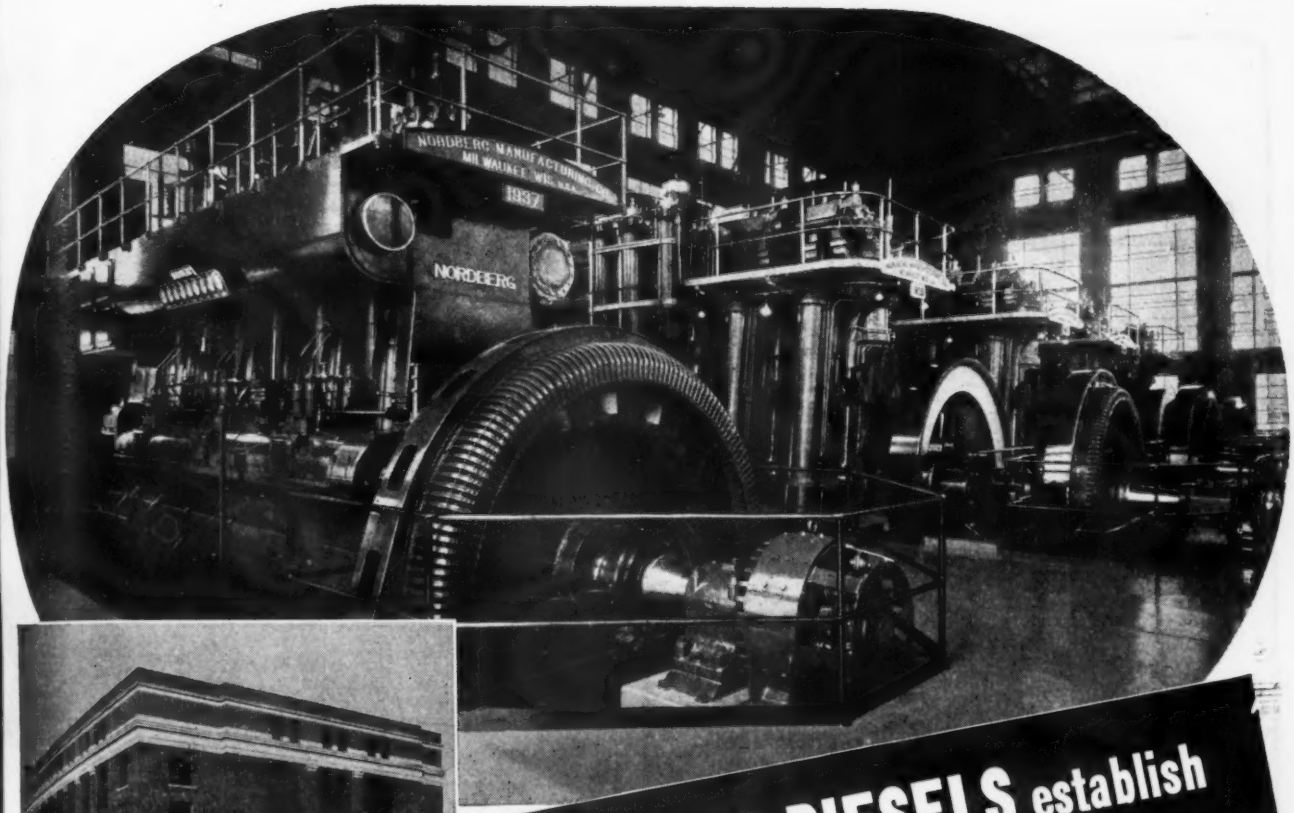

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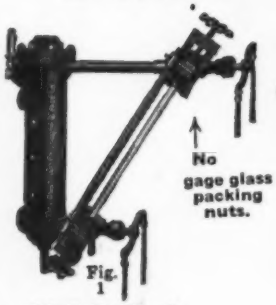

Fig. 1
with Split-Gland Gages Inclined

Water Columns HIGH & LOW Alarm

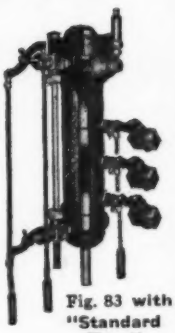

Fig. 83 with "Standard Type" Vertical Gages

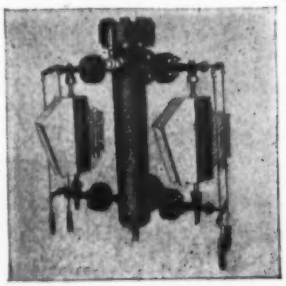

Fig. 85

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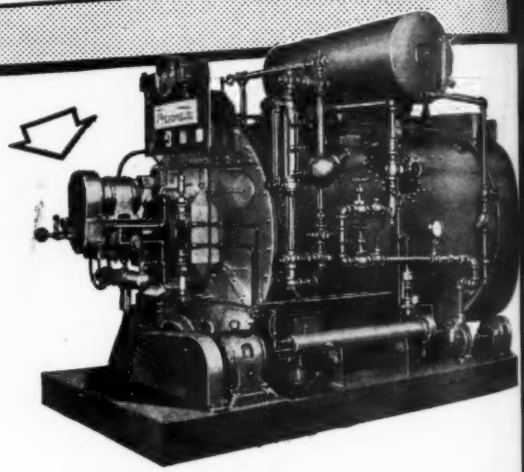

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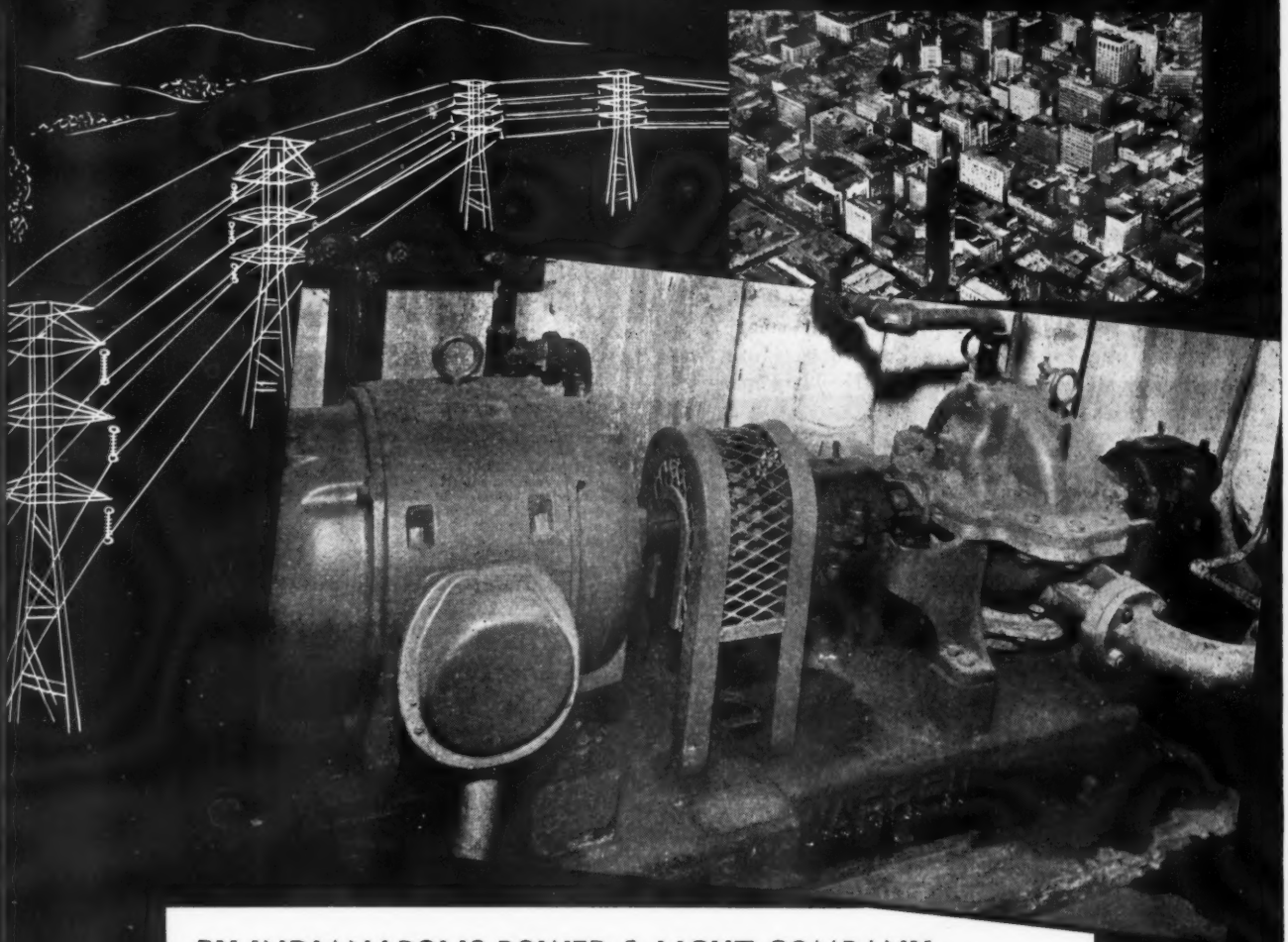

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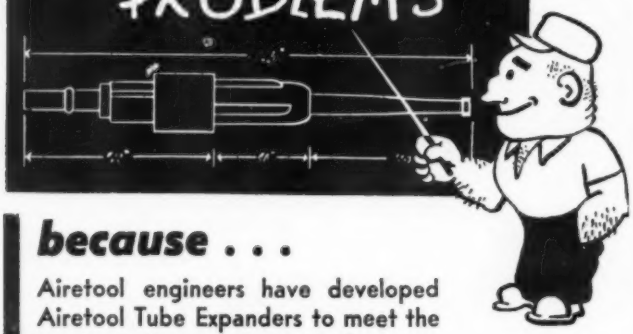

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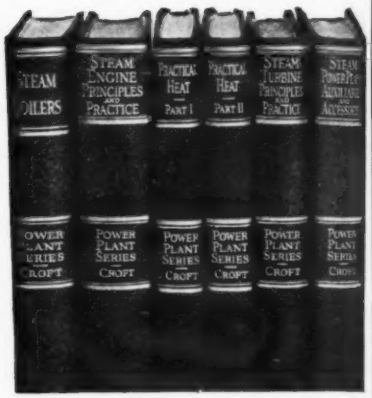
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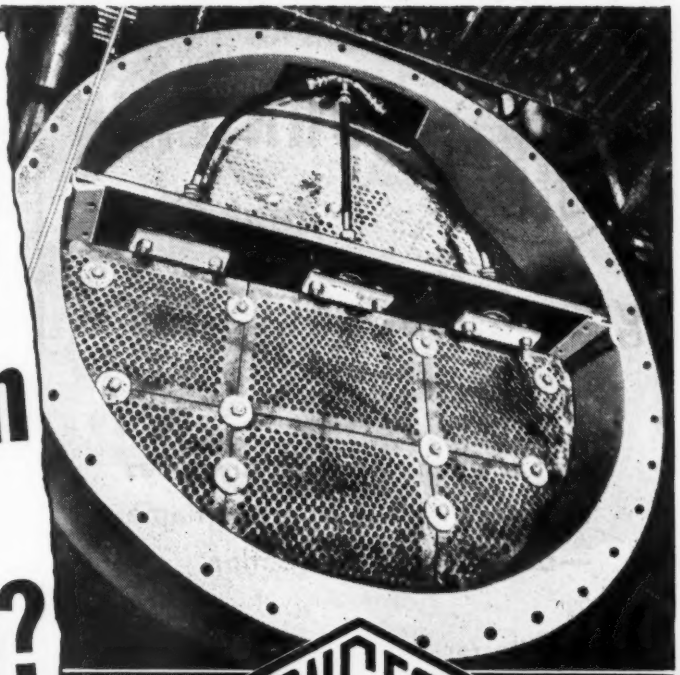

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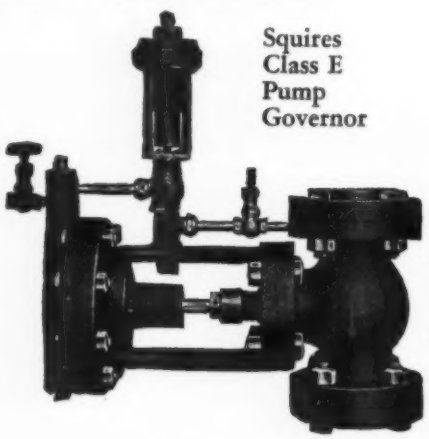

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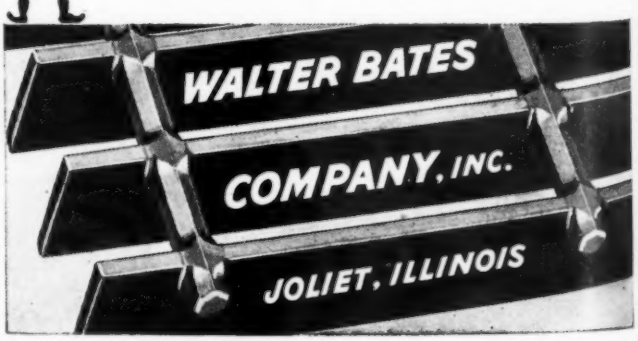

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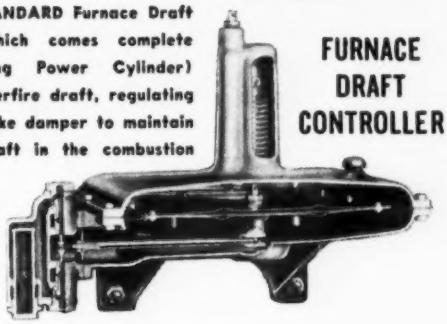
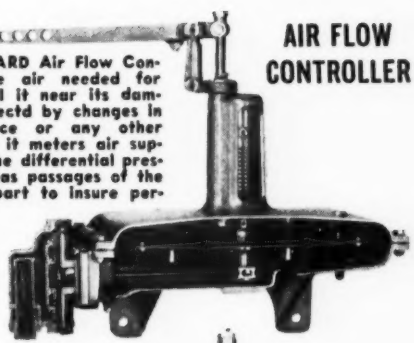
FURNACE DRAFT CONTROLLER



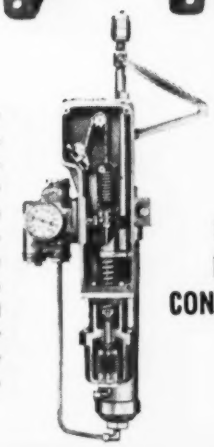
This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affectd by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

AIR FLOW CONTROLLER



This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

FUEL FEED CONTROLLER



A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

Cracked Concrete Floors Invite Trouble

Repair Them Overnight with SMOOTH-ON

No. 7B QUICK PATCH CEMENT

This quick-drying iron repair cement, applied tonight, can be safely trodden on or wheeled over tomorrow morning. What's more, patches made with it stick firmly in place—and *last*. For Smooth-On expands slightly as it hardens, adhering tightly to surrounding surfaces.

Cracks, holes and ruts in concrete *never stand still*. Don't wait for them to spread and enlarge and cause accidents—start using Smooth-On Quick Patch NOW. Inexpensive. Easy to use. Just mix to a putty with water and apply. Order Smooth-On No. 7B Quick Patch in 5-lb., 25-lb. and 100-lb. sizes.

FREE Quick Patch Folder, Repair Handbook

Send coupon for descriptive Quick Patch folder and receive also the free 40-page Smooth-On Repair Handbook showing ingenious repairs to plant and home equipment made with the other Smooth-On Cements. 170 diagrams. Pocket size.

Fill Out and Mail NOW

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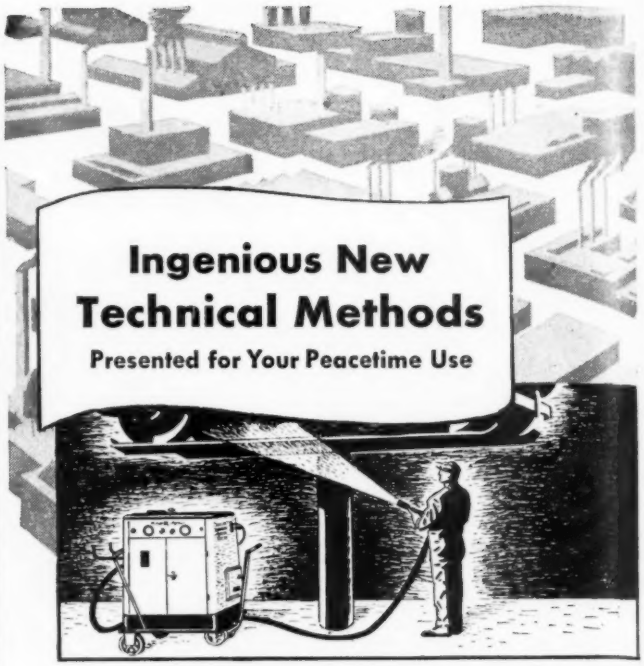
570 Communipaw Ave., Jersey City 4, N. J.
Please send me Quick Patch folder and Smooth-On Repair Handbook.

Name.....

Address.....

7-45 .....

Do it with SMOOTH-ON
The Iron Repair Cement of 1000 Uses

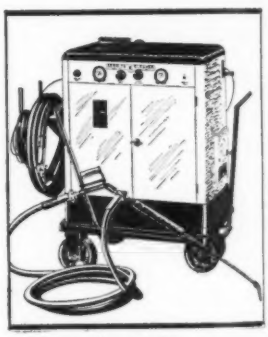


Coming to Users of Gas-Powered Equipment

80% SAVINGS IN CLEANING TIME

with Steam Rig Now the Army's Standby

An economical solution to the problem of cleaning and degreasing trucks, passenger cars, tractors, locomotives, excavators, and the like will be available to garages, service stations, all users of oil-burning equipment, as soon as war demands permit. It is a more efficient steam cleaner now in use by the thousands in the Armed Forces.



The Kerrick Kleaner

Neat "housekeeping" has too often been neglected by industry due to the costliness of hand labor. But the best housekeepers in the World, the U. S. Army, Navy and Marine Corps, dare not neglect frequent and thorough cleaning of all equipment to safeguard against fire and malfunctioning, and to permit fast, certain inspection. This cleaner, developed to meet their high standards, removes grease, dirt and grit 5 times as fast as any other method. It cleans by a balanced combination of heat, detergent, water and friction. It is typically "army" in simplicity of design and operation; in 30 minutes, the entire machine can be dismantled and completely cleaned.

Wartime uses of Wrigley's Spearmint Gum also point the way that industry may benefit when this quality product again becomes available. It will *again* be a "help on the job" in many ways. Right now *no* Wrigley's Spearmint is being made, as present conditions do not permit the manufacture of Wrigley's Spearmint in quantity and quality sufficient for all. But remember the Wrigley's Spearmint wrapper—it is a certificate of highest quality and flavor—and will always remain just that.

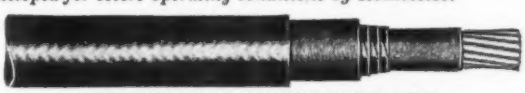
Remember this wrapper

You can get complete information from Clayton Manufacturing Company Alhambra, California

Z-75

ARE WIRE-FAILURES GIVING YOU A BLACK EYE?

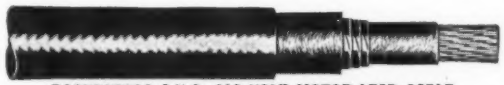
A few of the 125 different permanently insulated wires and cables developed for severe operating conditions by Rockbestos.



ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA—max. operating temp. 110°C.)

Sizes No. 18 AWG to 2,000,000 CM insulated with felted asbestos and varnished cambric, and covered with an asbestos braid. Other constructions for service voltages up to 5000.

This cable is recommended for power circuits and hot-spot wiring in or around boiler rooms, ash pits, steam tunnels, soaking pits, tenter frames, glass plants, steel mills, etc. The asbestos and heat-sealed varnished cambric construction has ample moisture resistance and withstands high temperatures indefinitely.



ROCKBESTOS A.V.C. 600 VOLT MOTOR LEAD CABLE
(National Electrical Code, Type AVA—max. operating temp. 110°C.)

Sizes No. 18 AWG to 1,000,000 CM insulated with two walls of felted asbestos and a high-dielectric varnished cambric insert, with a heavy asbestos braid overall.

Heatproof, fireproof, greaseproof and oilproof, this cable will not dry out and crack, won't burn or carry flame, and will remain permanently flexible. For coil connections, motor and transformer leads where overloads, extreme heat and fire hazards are encountered as in steel mills, boiler rooms, etc.

ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

In one to 19 conductors with individuals insulated like Motor Lead Cable, cotton braid covered, and cabled with an asbestos braid over all. Standard strandings AWG No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.

Is your producing machinery missing in action too often because power leads are failing under insulation-baking overloads? Are heat-weakened control circuits causing too much time-out? Do oil-soaked motor leads give up just when everything should be humming?

Then you're due to go in for some wire-failure elimination with Rockbestos A.V.C. *permanently insulated* wires and cables . . . built to take the heat up to 230°F. without drying out, cracking or flowing under the baking . . . and without rotting or blooming when exposed to oil, grease, alkalies or corrosive fumes.

For failure-free circuits install Rockbestos A.V.C. alongside blistering steam lines and kilns, in thermometer-boosting boiler rooms and tunnels, and around forging presses, soaking pits and steel mill furnaces . . . in fact, anywhere that other wires are kicking out too often.

Send for our catalog showing a complete line of *permanently insulated* Rockbestos wires, cables and cords, including many of the 125 standard constructions and National Electrical Code types we designed for failure-prevention. Write to the nearest district office or:

ROCKBESTOS PRODUCTS CORPORATION
999 Nicoll St., New Haven 4, Conn.

FOR VICTORY . . . BUY WAR BONDS

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

One investment that still yields ....a big return

Few and far between are the investments in a plant that will yield the rate of dividends you can get from properly designed, well constructed baffles. Yet in far too many plants this fact is overlooked. Too often the cost of a good baffle installation is paid over and over again in fuel waste caused by leaky or inefficiently designed baffles.

If you doubt this, investigate the operating records of plants that have placed the critical job of engineering and building baffles in the experienced hands of the Beco-Turner engineering staff. Beco-Turner baffles are designed by men who have had broad experience with practically every combination of boiler, furnace, and fuel burning equipment. They have the "know-how"—the "what-does-it".

And Beco-Turner construction is as far ahead as Beco-Turner design. Beco-Turner baffles are cast in place—therefore have no structural limitations. Their patented expansion joints, illustrated below, prevent cracks and make them positively gastight. You have baffles that are designed right and built right when you install Beco-Turner.

Are you paying for them without *having* them? Why not send us blueprints of your present or contemplated boilers for a dollar-saving recommendation. There is no cost or obligation whatever.

Plibrico Jointless Firebrick Co.
1818 Kingsbury St. (Dept. G.), Chicago 14, Ill.

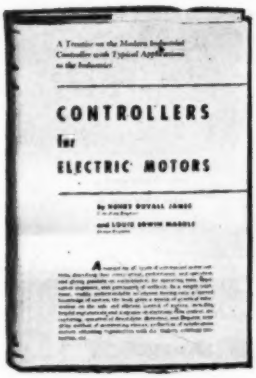
EXPANSION JOINTS PREVENT CRACKS

Beco Turner Baffles

How to select · operate · maintain the *right* controller for your electric motor power

Here is your controller guide for selecting and using the control apparatus that will best harness your electric motor power to your load requirements. This book takes the guess-work out of control purchase and presents the operator with all the facts on controller operation and design. Hundreds of diagrams, illustrations, curve charts and tables, together with a simple, direct text, instruct operating men, engineers, purchasers of control on each detail of proper selection, operation and maintenance.

Just Published!



Controllers for Electric Motors

By HENRY DUVALL JAMES
Consulting Engineer, Pittsburgh, Pa.
and LOUIS EDWIN MARKLE
Design Engineer

324 pages, 6½ x 9¾, 276 figures, 6 tables, $3.50

This book brings you up to date on the latest control apparatus—new uses of the electron tube, magnetic contactors, time-limit method of acceleration, development of plugging control, and of the Regulex, Ampledyne and Rotorol, and new types of time-delay overload relays. Here is analysis of popular commercial types, and most successful methods of accelerating motors, speed control, mechanical and dynamic braking, regeneration, and voltage control for d-c motors, with special sections on protective devices, national codes, installation and maintenance, and future control developments.

CHAPTERS

Function and Types of Control
How to Read Controller Diagrams
How to Make Controller Diagrams
Magnetic Contactors
Starting Characteristics of Motors with Different Methods of Control
Methods of Accelerating Motors
Methods of Speed Control
Control for Special Applications
Mechanical and Dynamic Braking
Regeneration
Voltage Control for Direct-current Motors
Series-Parallel Control and the Electropneumatic Contactor
Adjustable-speed Alternating-current Motors of the Wound-rotor Type
Types of Resistors
Manual Controllers
Direct - current Magnetic - contactor Controllers
Alternating-current Controllers
Synchronous-motor Control
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Protective Devices
National Codes, Installation, and Maintenance
Future Control Developments

Detailed information on:

Functions, types, advantages and limitations of magnetic contactors; Deion principle of arc rupturing; Use of two power tubes to give more uniform d-c power; Time-limit methods of accelerating motors; Motor-generator control of motor voltage; New types of time-delay overload relays; etc., etc.

See it 10 days FREE

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Send me James and Markle's Controllers for Electric Motors for 10 days examination on approval. In 10 days I will send $3.50, plus few cents postage, or return book postpaid. (Postage paid on cash orders.)

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WING *Revolving* UNIT HEATERS

Many who have been aware of the superiority of Wing Revolving Unit Heaters for wintertime heating are just discovering for themselves the added value of these "heaters" in summer, when, with the steam turned off and the fans on, the revolving discharge outlets circulate the air with a pleasant cooling effect that reaches all workers uniformly.

As the moving streams of air sweep slowly around through 360 degrees, they cover successively every direction, mixing the air uniformly and creating a delightful cooling effect that is equally effective in stimulating production in hot weather as is accomplished with the heated air in winter.

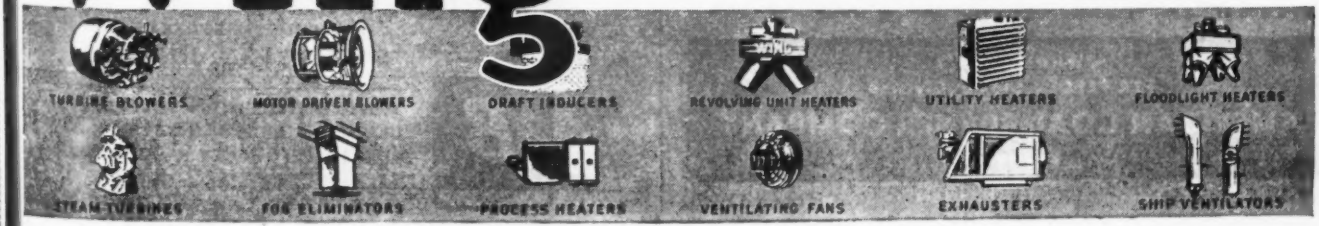
Write for a copy of Bulletin HR-4.

Wing

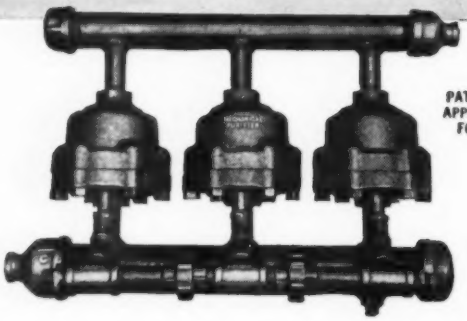
L. J. Wing Mfg. Co.

50 Seventh Ave., New York 11, N. Y.

Factories in Newark, N. J. and Montreal, Canada



Purify Any Pressures, Air or Gas, with Bird-White Multiple Unit *Pur-O-fier*



PATENT APPLIED FOR

Three Models Available

Model A-1 furnished with a 1 inch turbo-rotor and will accommodate volumes from 1 to 8 cubic feet.

Model A-2 has a 2 inch turbo-rotor and can accommodate volumes from 10 to 35 cubic feet.

Model A-4 has a 4 inch turbo-rotor and can accommodate volumes from 35 to 100 cubic feet.

Bird-White multiple unit Pur-O-fiers save time and money by protecting air-operated machines, gauges and controls from contamination. They give positive purification to air or gas lines regardless of fluctuating pressures or high volumes.

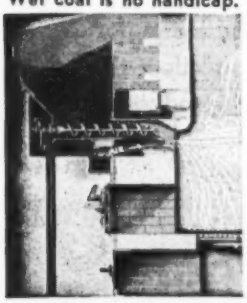
The perfectly balanced Turbo-Rotor purifying action makes them sensitive to both regular and intermittent pressures. Write for Bulletin 10 giving complete details.

BIRD-WHITE COMPANY
Dept. PM,
3119 W. Lake Street • Chicago 12, Ill.

FYR-FEEDER MULTIPLE SPREADER STOKERS

BURN COAL LIKE OIL!

Save with Fyr-Feeder — Burn less Coal — Cheaper coal — Local coals — Screenings — Coal yard sweepings, wet or dry — Wet coal is no handicap.



FYR-FEEDER
exclusively uses
Air JET Coal PROPULSION

Fines burn in suspension, larger pieces are spread evenly over grates.

Fyr-Feeder increases boiler capacity—responds instantly to sudden load variations—requires no special skill or experience to operate—thin fuel bed eliminates clinkers—makes firemen's work much easier—no banking losses.

CHANGE OVER TO FYR-FEEDER NOW!
Easily installed in minimum time.

Fyr-Feeders are built in sizes to burn from 300 to 12000 lbs. of coal per hour. If you are or expect to be in the market for automatic coal burning equipment

Wire or Write
FYR-FEEDER Stoker Division
AMERICAN COAL BURNER COMPANY
Engineers

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Burlington

VOLTAGE REGULATORS

Rugged, sensitive and fast acting voltage regulators for portable and stationary generating plants. Model G-L-1 for small AC sets up to 30 K.W.; SR Synchrostat for AC Power Units up to 100 K.W.; Model GB for AC generators up to 3,000 K.W. DC Regulators built in sizes up to 1,000 K.W.

AUTOMATIC SYNCHRONIZERS

Automatically controls circuit breaker closure of AC generators in paralelling to a common bus. Advantages are (1) greater accuracy, (2) quiet, (3) positive, (4) safe, (5) economical, (6) multiple control, (7) easily installed, (8) long life.

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A complete line of AC and DC Microammeters, Milliammeters, Ammeters, and Voltmeters available in 2½", 3½" and 4½", round or square, flush mounting. Their guaranteed accuracy and satisfactory performance is the result of skilled design, careful manufacturing, and quality materials.

Write today for full details of Burlington Products. Our engineers will gladly recommend the precision Burlington equipment best suited for your purpose.

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700 FOURTH STREET
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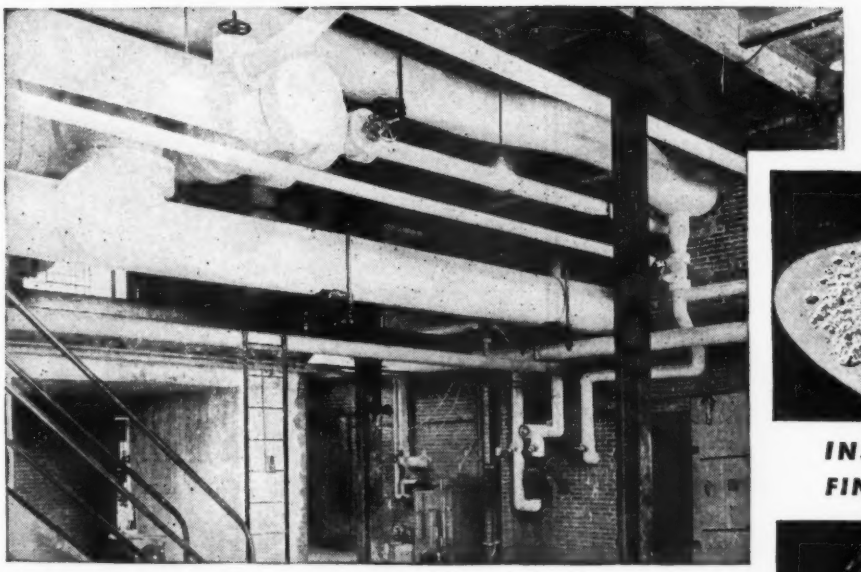
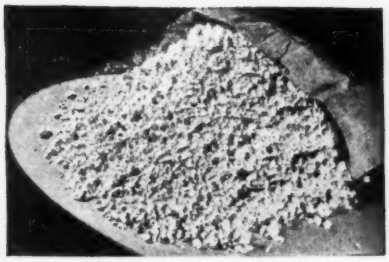
PANEL INSTRUMENTS • VOLTAGE REGULATORS • AUTOMATIC SYNCHRONIZERS • FREQUENCY REGULATORS

★"shipshape" appearance





INSULATING AND FINISHING CEMENT

...another job for

FIBERGLAS*

In co-operation with the Government program to save critical fuel.

Fiberglas Insulating and Finishing Cements are excellent companion items used with Fiberglas Insulations in covering pipes, boilers, retorts—all sorts of heated vessels.

Fiberglas Insulating Cement provides a monolithic insulation for pipe bends, fittings, irregular shaped vessels. It combines excellent thermal insulating value with ease of application. This material can be used over steel, brick and insulation blocks and metal mesh blankets. When located outdoors or exposed to moisture or abrasion a protective jacket or a coating of OC Mastic finish should be applied to protect the cement. *Fiberglas Insulating Cement* is made of modulated Fiberglas Insulation, dry-mixed with refractory-type materials. It is reclaimable up to 1000° F., has low shrinkage and provides an excellent base for Fiberglas Finishing Cement or OC Mastic finish.

Fiberglas Finishing Cement provides a smooth, attractively finished exterior surface when properly applied over the Fiberglas Insulating Cement base. Made of a combination of light-density Fiberglas and suitable binders, it is easy to mix and may be used as a scratch coat, finish coat or both.

There is a form of Fiberglas Insulation Material to meet virtually every industrial need—in the power plant and out through service and process lines. If you do not have complete information on the materials listed in the panel at the right, write today for "Fiberglas Insulations for Industry" . . . *Owens-Corning Fiberglas Corp., 2000 Nicholas Bldg., Toledo 1, Ohio.*

In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

FIBERGLAS INDUSTRIAL INSULATIONS

1. Blanket Type Pipe Insulation—With mesh wire on outer side to wrap around pipe and secure with wire through special edging. Manufactured in 2-ft. sections for pipes over 3" O.D. Will withstand temperatures up to 1000° F.

2. Metal Mesh Blankets—With mesh wire or expanded metal on one or both sides. Lightweight and easily applied. 2 ft. x 4 ft. and 2 ft. x 8 ft. In standard thicknesses. Two types: For temperatures up to 600° F. and 1000° F.

3. No. 600 PF Block—Same materials as in PF Pipe Covering — in blocks 6" x 36" and 12" x 36", standard thicknesses.

4. OC-1800 High Temperature Block—A highly efficient molded block in sizes 3" x 18" and 6" x 36" and 12" x 36"—in standard thicknesses. Will withstand surface temperatures up to 1800° F.

5. Insulating Cement—For insulating fittings, valves and all irregular surfaces. Highly efficient . . . withstands temperatures up to 1200° Fahrenheit.

6. OC Mastic Finish—An asphalt emulsion cement for insulated pipe and equipment exposed to outdoor or high moisture conditions.

7. Insulating Wool, Type TW-F—Available in bats, rolls and bulk. Used for drying-ovens, heaters, etc., for filling irregular spaces.

8. PF Insulation—Manufactured in 5 densities from 2½ to 9 lbs. per cu. ft.—standard sizes 24" x 48", 1" to 4" in thickness, according to density. For insulated panels, sound absorption and various semi-structural applications.

9. PF Roof Deck Insulation—9 lbs. density with facing to facilitate mopping. Highly efficient, with incombustible, rotproof and moisture-resistant core, for application under industrial built-up roofings. Sizes 24" x 48". Thicknesses from 1⅛" to 2".

ARMY E NAVY

FIBERGLAS

*Trade Mark Reg. U. S. Pat. Off.

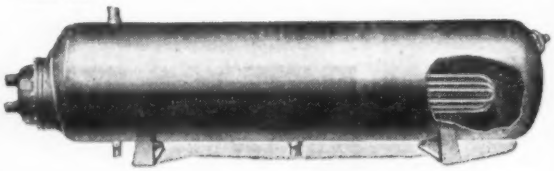
INDUSTRIAL INSULATIONS

NEW BULLETIN ON HEAT EXCHANGERS

A copy of Bulletin No. H-1 is yours for the asking. It illustrates the line of Brownell heat exchangers, generators, and converters for heating water with live or exhaust steam. Hourly capacities range from 60 to 4,400 gal.; storage capacities, from 25 to 1,904 gal.

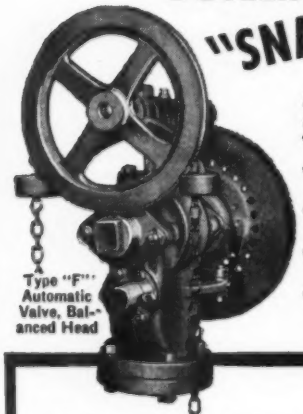
We suggest that you drop us a request for the bulletin now while the subject is on your mind.

Brownell agents in all principal cities have the knowledge and facilities to give you superior heating service.



THE **BROWNELL** CO.
306 N. FINDLAY ST.
DAYTON 1, OHIO

BOILERS "SNAP OUT OF IT!"



Type "F" Automatic Valve, Balanced Head

MARION SOOT BLOWERS **modernize boilers right now! They do this work:**

- **Increase boiler capacity and flexibility**
- **Save 5 to 10 percent on fuel bills**
- **Do the job mechanically and quickly**
- **Blow out soot deposits without injury to baffles**

● **Soot slows boilers down.** ***MARION SOOT BLOWERS*** **eliminate stubborn soot with minimum waste of steam. Type "F" for water tube boilers blows in any length of arc from 15 to 345 degrees. No lugs, stops, pawls, nor pins. "Keeps on Rollin' " to right or left as desired. Favorites with skilled engineers and power plant owners,** ***MARION SOOT BLOWERS*** **are made for all sizes and types of boilers. Parts are interchangeable. Continuous service with low replacement and repair cost.**

Write for Specifications and Prices
Save Coal, Time and Worry

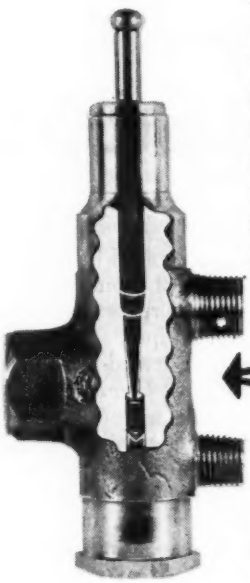
THE MARION LINE

Marion Machine, Foundry and Supply Co. • Marion, Indiana, U. S. A.

Halt NEEDLESS WASTE OF Power!

Such a small operating part as a stem... its design and structure, its finish, can mean the difference between costly power loss and real *saving* of fuel, steam, power . . . controlling dampers and valves.

LOCKE REGULATOR
STEM **STOPS..**



— innumerable times in its movement up or down within the pilot valve, according to the pressure motivating it—because of its exclusive design which permits a halt at any point in its travel. Precision hand-tooled, this stem adds to Locke Regulators' extreme sensitivity in controlling dampers and valves.

Increase or decrease of pressure operating the Locke Regulator produces corresponding response in the thrust of the Locke stem which ordinary machined units cannot deliver. A new catalog describing Locke Regulators should be in your reference and purchase files.

A catalog will be forwarded upon your request.

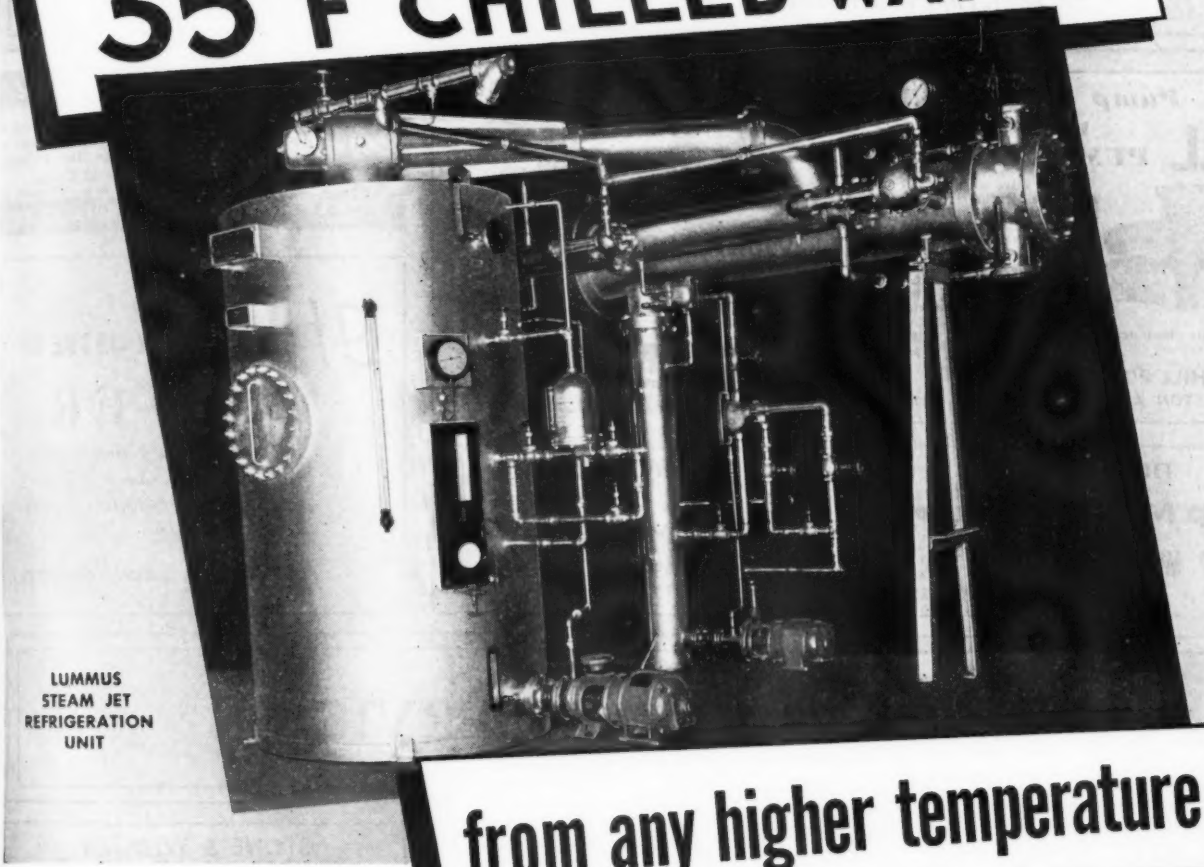
DIVISION OF THE H. T. WILSON MACHINE CO., INC.

LOCKE REGULATOR COMPANY

WALTER AND OSBORNE STREETS
SALEM, MASSACHUSETTS

MODEL REGULATORS · DAMPER REGULATORS · FAN ENGINE REGULATORS · BA
PRESSURE VALVES · BALANCED VALVES · ELECTRIC VALVES · REDUCING CONTRO
FLOAT CONTROLS · PILOT CONTROLS · PUMP GOVERNORS · VACUUM BREAK
ENGINE STOPS · MASTER REGULATORS · OIL CONTROL VALVES · SOLENOID CONTRO

35° F CHILLED WATER



LUMMUS STEAM JET REFRIGERATION UNIT

from any higher temperature

LUMMUS EQUIPMENT

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PROCESS CONDENSERS
•
REBOILERS
•
STEAM GENERATORS
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STEAM JET REFRIGERATION
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STEAM SURFACE CONDENSERS
•
BAROMETRIC CONDENSERS
•
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•
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•
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•
FUEL OIL HEATERS
•
LUBRICATING OIL COOLERS
•
PIPE LINE COOLERS
•
FEED WATER HEATERS
•
JACKET WATER COOLERS

Lummus experience . . . in designing and fabricating steam jet refrigeration units for any range of operating temperatures . . . provides economical refrigeration through the use of minimum quantities of steam and condensing water.

Cooling water is chilled by the vaporization of part of the water by means of a vacuum maintained above the water's surface. The vacuum is created by jets using either exhaust or live steam. Cooling speed can be controlled automatically or manually.

Designed for simple operation, long life, low maintenance and operating costs, Lummus chilled water units are available in fully standardized sizes to meet a wide range of operating requirements and plant conditions.

Lummus engineering service is always available for the study of specific surface or barometric condenser type steam jet refrigeration problems. For further information write to: The Lummus Company, 420 Lexington Avenue, New York 17, N. Y.

LUMMUS

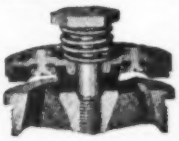
STEAM JET REFRIGERATION

WHERE TO BUY

Featuring additional products and specialties for power plants

End Pump Troubles!

HILL IMPROVED PUMP VALVES



• The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate. Send today for bulletin that tells how to get better pump performance.

HILL PUMP VALVE CO.
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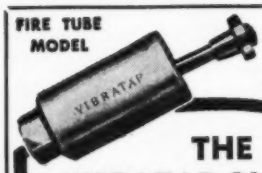

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THE VIBRATAP CLEANER

Does a fast and thorough job of removing scale from boiler tubes—saves coal, improves boiler performance. Write for Bulletin V-20.

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Automatic Control

For Industrial Processes, Heating and Air Conditioning Systems, Hot Water Heaters and Shower Baths. Write for Bulletins.

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Tripp Metallic Packing

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So why not save time by calling in a specialist who knows the ground you are exploring?

POWER, meeting place of power men in all parts of the country, points the way to the solution of many power problems through its Professional Service Section.

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Established 1909
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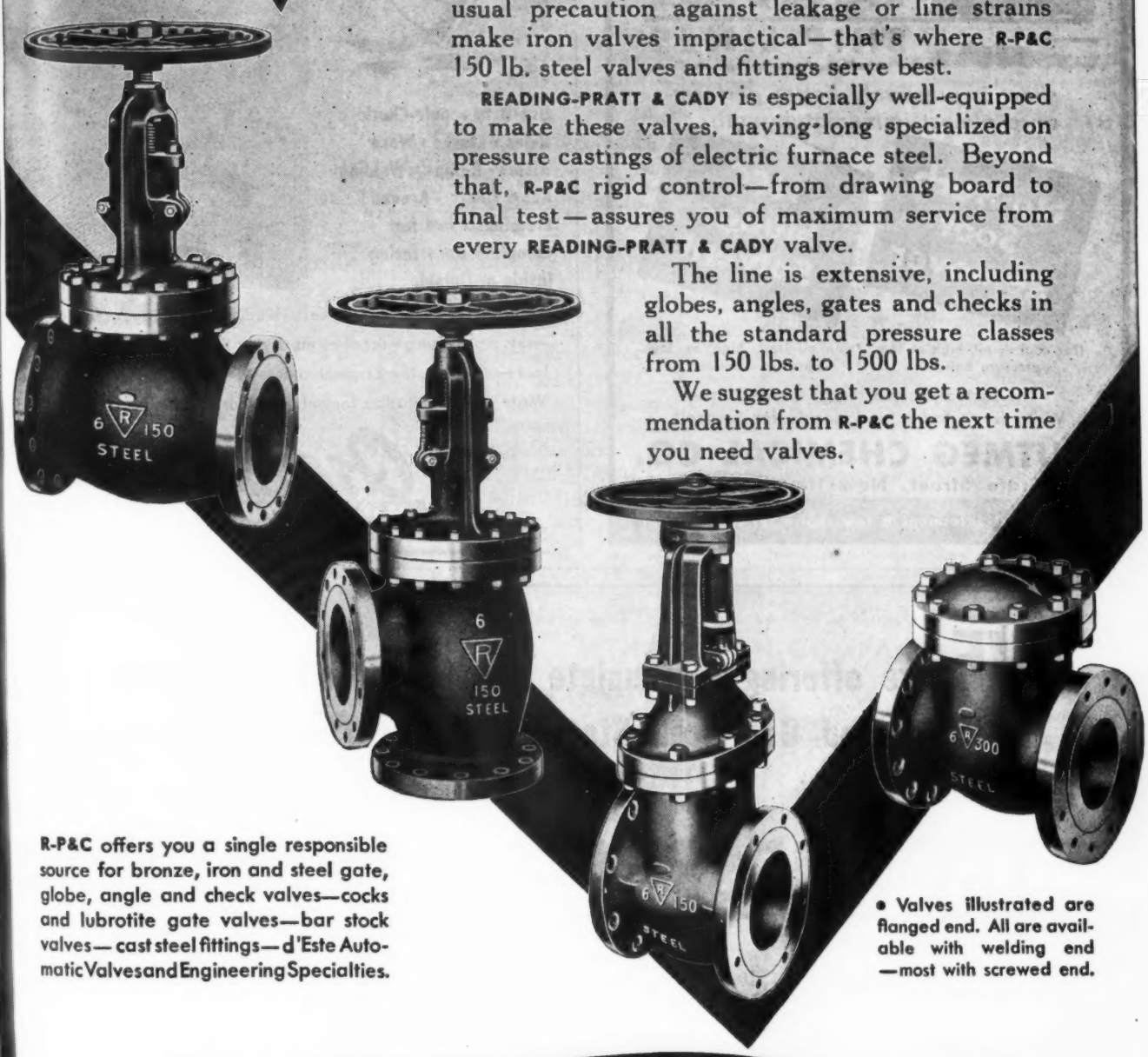
Where conditions of service call for STEEL

. . . in the low pressure range where high temperature, corrosive liquids, fire hazards or need for unusual precaution against leakage or line strains make iron valves impractical—that's where **R-P&C** 150 lb. steel valves and fittings serve best.

READING-PRATT & CADY is especially well-equipped to make these valves, having long specialized on pressure castings of electric furnace steel. Beyond that, **R-P&C** rigid control—from drawing board to final test—assures you of maximum service from every **READING-PRATT & CADY** valve.

The line is extensive, including globes, angles, gates and checks in all the standard pressure classes from 150 lbs. to 1500 lbs.

We suggest that you get a recommendation from **R-P&C** the next time you need valves.



R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—d'Este Automatic Valves and Engineering Specialties.

• Valves illustrated are flanged end. All are available with welding end—most with screwed end.

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READING-PRATT & CADY DIVISION
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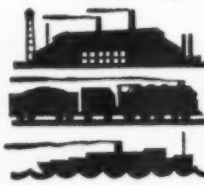
In Business for Your Safety

HIGHEST-PAID
ENGINEERS
of Outstanding



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RAILROADS
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No-Karb Soot Remover
(for coal or oil, high or low pressure boilers)

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(for oil-fired, high or low pressure boilers)

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Write for it today and decide for yourself.

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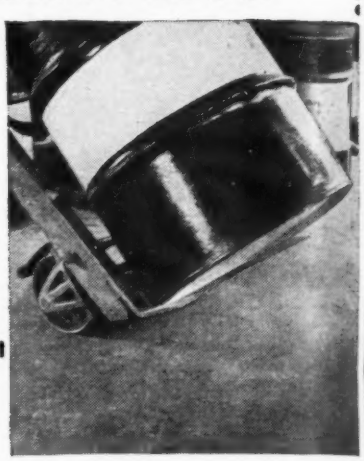
Keep Floors Level—Speed Traffic with *Quick-Floor*



Use it to repair Chuck Holes • Cracks • Worn Aisles • Ramps • Welding Room Floors • Around Re-set Machines • And for Complete Resurfacing Inside or Outside

QUICK-FLOOR is ready-mixed—is easily laid (a square foot a minute)—sets by pressure—requires no drying time—can be used as soon as laid—outwears the original concrete. Unconditionally guaranteed. Write or phone today for help on your specific problems.

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WE are offering a complete and improved line of automatic Oil and Gas-Fired Steam and Hot Water Generators

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The Design and Construction is the result of Experience gained through the manufacture by us of thousands of Automatic Oil and Gas Fired Units operating in all parts of the world, plus—

100 Years of Boiler Building Experience in all types of Boilers

Consult our Engineers about your Boiler Problems or Requirements

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BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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The advertising rate is $7.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. P.

NEW ADVERTISEMENTS received by July 16th will appear in the August issue, subject to limitations of space available.

POSITIONS VACANT

WANTED: MECHANICAL and structural designer-draftsmen, thoroughly experienced in steam-electric power plant design and including piping and other related detailing. Work on drafting board. Send synopsis of training and experience including references, representative samples of design and draftsmanship, salary desired and earliest date could report for employment in Consulting Engineer's office. Location North Carolina. WMC regulations apply. P-838, Power, 330 W. 42nd St., New York 18, N. Y.

CHIEF DESIGN Engineer for old established valve manufacturer of automatic control equipment, permanent position as head of engineering department, advise age and qualifications. P-847, Power, 330 W. 42nd St., New York 18, N. Y.

VALVE ENGINEER—experienced in mechanics and hydraulics, wanted by manufacturer of air, gas and liquid control and shut-off valves, manual and automatic, to take charge of engineering department and supervise design, development and test work. Attractive, well-paying position. P-863, Power, 330 West 42nd St., New York 18, N. Y.

POWER PLANT Contractor located in Midwestern city is interested in obtaining services of competent power plant piping engineer and draftsman familiar with high pressure piping work and generally familiar with high pressure power plant practice. Some knowledge of structural steel and building design desirable but not essential. Position available of permanent character not dependent upon war work as contractor now engaged almost entirely on private public utility and industrial construction and design. Give full particulars as to age, experience and salary requirements. P-864, Power, 520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL ENGINEER familiar with steam power plant work for permanent position with midwest engineering firm as assistant to head of mechanical engineering section. Good opportunity. Give complete experience record and statement of availability. P-865, Power, 520 N. Michigan Ave., Chicago 11, Ill.

EASTERN GAS and electric utility desires two graduate engineers, with about five years experience, for mechanical plant betterment work in field and office. Duties consist of steam plant testing and results analysis. Statement of availability required. P-866, Power, 330 W. 42nd St., New York 18, N. Y.

WANTED: CHIEF Engineer to take charge of boiler room and power generation in large Michigan paper mill using turbines and corliss and high speed engines. In reply, give outline of experience and availability for interview. P-867, Power, 520 N. Michigan Ave., Chicago 11, Ill.

FIRE PROTECTION Engineers and inspectors. Technical graduates, especially chemical and electrical, civil, mechanical, metallurgical also considered. Inspect and consult industrial plants to prevent fires, explosions, and other casualties. Considerable travel and report writing; interesting work offering permanency. Engineering experience necessary. Salary open. Well-known national organization with openings at Cleveland, Chicago and other district centers. Men under 34 years of age cannot be considered. Please send photograph when applying. P-868, Power, 330 W. 42nd St., New York 18, N. Y.

Additional Employment Advertising on page 330

ENGINEERS and DRAFTSMEN

Electrical—Mechanical—Structural

We have openings for capable engineers and draftsmen in the following branches of engineering—

ELECTRICAL—Industrial lighting, Power distribution, and Electronic controls and devices.

MECHANICAL—Power plants, Heating systems, Process piping, Conveying systems, Plumbing, Sewers, Sprinkler work, and Precision machine design.

STRUCTURAL—Industrial buildings, Power plants, and Miscellaneous structures of steel and reinforced concrete.

Opportunities are in the West Coast, Cleveland, Chicago, New York and Gulf Coast areas.—Vital war plants important to the United States Government under high priority ratings.—Recent graduates will be considered.

Applicants must conform with Local War Manpower Regulations.

THE AUSTIN COMPANY

National Headquarters

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PREFER man about 40 with SOME PRACTICAL ENGINEERING EXPERIENCE. Position consists of preparing Booklets dealing with Lubrication of various types of machinery. PERMANENT POSITION Major Oil Co. Located in N. Y. C.

STARTING SALARY $5000

Give full details including Age, Experience, Education.

Box S-901, Finneran, 1475 B'way, N. Y. 18

DRAFTSMEN WANTED

for both Centrifugal and reciprocating pump work. Permanent positions and desirable working conditions. Experience in pump work preferred but all applicants will be considered.

WARREN STEAM PUMP CO., INC.
WARREN, MASS.

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Experienced in power, industrial, and processing plants. Location, New York City.

EBASCO SERVICES INC.
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POWER ENGINEERS

Mechanical Engineers or Electrical Engineers, with aptitude and experience in heat balance thinking for work devoted to plant improvements, results engineering and effecting economy in the generation and consumption of steam, electricity, compressed air, water and refrigeration. Several openings for qualified men at different locations in the United States.

Give full experience, education, age, present salary and salary expected. Enclose snapshot.

Post-war opportunity.

Applicants must be able to obtain Statement of Availability.

E. I. du Pont de Nemours & Co., Inc.
Personnel Division
Wilmington 98, Delaware

(Continued from page 329)

EMPLOYMENT SERVICE

SALARIED POSITIONS — This advertising service of 35 years recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

POWER & MAINTENANCE Engineer desires connection with industrial company as superintendent of power, chief engineer or electrical superintendent. Twenty-five years in steam and electrical field with high and low pressure boilers, automatic combustion control, turbines and all types of electrical equipment including shop supervision. Technical education. Available now. PW-869, Power, 520 N. Michigan Ave., Chicago 11, Ill.

ENGINEER: POWER plant and/or maintenance; technical education, 34 years old; diversified practical mechanical and electrical experience; can plan and supervise preventive maintenance program; thoroughly familiar with conbustion and efficiency problems; now available. PW-870, Power, 330 W. 42nd St., New York 18, N. Y.

CHIEF ENGINEER: Centrifugal pumps. Experienced all engineering and manufacturing branches. Modern, efficient, economical standardized or special design. All types. Existing lines modernized. Executive many years. Present location Mass. PW-871, Power, 330 W. 42nd St., New York 18, N. Y.

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SALES ENGINEER: offers to represent good line of power plant equipment on exclusive agency basis. Thorough knowledge of steam and diesel. Thoroughly familiar with Chicago and surrounding states. SA-872, Power, 520 N. Michigan Ave., Chicago 11, Ill.

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ANYTHING within reason that is wanted in the field served by Power can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

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Manufacturer offers excellent opportunity to right man with good contacts. Full charge of sales. Write fully; all replies held in confidence.

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330 West 42nd Street, New York 18, N. Y.

Firm of Brazilian and American machinery merchants specializing in machine tools and power plant equipment with warehouses in Philadelphia and Rio de Janeiro and offices in principal cities of Brazil desires exclusive representation for Brazil of leading manufacturers on stocking distributor basis. All export details handled by Philadelphia office. For details and financial rating write:

MR. J. DE V. F.
c/o The O'Brien Machinery Company
113 No. Third St., Philadelphia, 6, Pa.

Distributor on commission basis desires equipment and products for New England States. Reply

RA-860, Power
330 West 42nd St., New York 18, N. Y.

UNIVERSAL TOOLS: NATIONALLY ADVERTISED BRANDS AND PRICES.
If it's Tools—We have it, Can get it, or It isn't made! *Price List & Order Blank Free!!*
UNIVERSAL TOOL COMPANY
O. B. Demattels, President
1527 Grand CA, Kansas City, Missouri.
IMMEDIATE SHIPMENT: OVERNIGHT BY AIR: TO ANYWHERE—USA.

WANTED

POWER ENGINEER

To take charge of the operation of industrial power house and related services such as air conditioning and water filtration for large manufacturing plant located in Western North Carolina. Applicants please state age, education, previous experience and salary desired; photograph or snapshot not returnable.

P-858, Power
330 West 42nd St., New York 18, N.Y.

WANTED

Engineering Draftsman

Large, old established Chicago concern. Should be experienced in Foundry layout and Plant Engineering work. Good future for applicant with right qualifications. Please give age, experience, references and salary desired.

P-861, Power
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Manager for our Machinery and Equipment Department Experienced with machinery and equipment used in heavy industries —like cranes, ground and overhead; steel buildings and structures, power plants, mining, contractors, etc. Drawing account and participation. Unusudl opportunity for good high grade man. Confidences respected.

IRON & STEEL PRODUCTS, INC.
40 years' experience
13438-A S. Brainard Avenue, Chicago 33, Ill.
"*ANYTHING* containing IRON or STEEL"

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STOKER

One 125 H.P. James Leffel Stoker for use in 125 Scotch Marine Boiler complete with 3 H.P. 220 V. 60 Cycle AC three phase motor. Cost new $2800. In use only sixteen months. Any reasonable offer considered. For further information address the

SOLAR COMPOUNDS CORPORATION
Linden, New Jersey

FOR SALE

4 FREDERICK STOKERS

Two 600 HD hopper seed side dump. Two 850 HD hopper seed side dump. Used only one season—in perfect condition. Also overhead monorail conveyor with two dump cars and electric hoist. Please inspect and submit reasonable offer.

RAYMOND R. BEATTY, INC.
30 Garth Road, Scarsdale, N. Y. Scarsdale 798

NEW STOKER FOR SALE

Detroit triple retort stoker, side dump, grate 10' 6" wide, 7' 6" long, 900 Boiler HP.

Includes Buffalo blower, Crocker-Wheeler motors 3-PH, 60 cy. 208 volts, and Carling steam turbine 11 HP, 130 lbs. pressure.

Equipment is new, and has never been installed.

Reasonably priced.

WOODWARD & LOTHROP
Washington 13, D. C.

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VOLTMETERS
AMMETERS
MILLIMETERS
MICRO AMMETERS
OHMMETERS
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VARIABLE TRANSFORMERS
RELAYS

Ask for Our Latest Availability List

ELECTRO-TECH
EQUIPMENT COMPANY
329 Canal St., New York 13, N. Y.

WANTED

Cash Ready

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ELECTRICAL EQUIPMENT

Electric motors, AC and DC.
Compensators
Generators
Motor Generator Sets
Air and Oil Circuit Breakers
Panels
Exhaust Fans
Control Equipment

Send us list with full details

WIRE OR PHONE

POWER EQUIPMENT CO.
154 ANDREWS ST., ROCHESTER 4, N. Y.
Telephone Main 568 or 569

WANTED

DIESEL ENGINES

Total 1600 HP required, with or without Generators. Consider units 225 HP and larger. Also smaller high speed units for standby service. Preference given units immediately available. Give complete details and price.

Address Purchasing Department
W-844, Power
330 West 42nd St., New York 18, N. Y.

WANTED

Diesel Engine 40 or 50 H.P. with clutch. Foreign or Domestic make. State full particulars—Price.

BLACK & WHITE CORP.
547 W. 130th St., N. Y.

HI-LIGHTS OF *Hemphill* VALUES!

You know that not all equipment needs rebuilding. But where it is needed, it's no job for the novice. Hemphill graduate ELECTRICAL ENGINEERS direct all necessary rebuilding, watch its progress closely, check and recheck the tests that establish its condition. Only after their unqualified "OK" can any piece of equipment be given the "Seal of Quality."

The Seal That Says

"AS GOOD OR BETTER"

The Hemphill Seal on equipment guarantees that the standard of test requirement is up to, or exceeds, that of the original manufacturer.

The Hemphill SEAL OF QUALITY GUARANTEES ENGINEERED RECONDITIONING

MOTORS—3 PHASE 60 CYCLE

1—500 HP, 900 RPM, Lincoln, 440 volt, slip ring.
1—400 HP, 1200 RPM, 220 volt, Westinghouse squirrel cage.
1—350 HP, 300 RPM, 440 volt, General Electric slip ring.
1—200 HP, 600 RPM, 2200 volt, G.E. sl. rg.
1—150 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
1—150 HP, 1750 RPM, Westinghouse, sl. rg.
1—150 HP, 400 RPM, 440 volt, General Electric squirrel cage.
1—125 HP, 1800 RPM, 2200 volt, Continental, squirrel cage.
1—100 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
2—100 HP, 450 RPM, 440 volt G.E., sq. cg.
1— 90 HP, RPM, 550 volt, Cr. Whir., sq. cg.
1— 75 HP, 1200 RPM, 440 volt, G.E., slip ring.
1— 75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1— 75 HP, 720 RPM, 440 volt, Westghse, slip ring.
1— 75 HP, 1200 RPM, G.E., sl. rg.
2— 75 HP, 900 RPM, G.E., sl. rg.
1— 60 HP, 1200 RPM, 220 volt, General Electric, slip ring.
1— 50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1— 30 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D. C. 230 VOLTS

2—450 HP, G.E., 440 RPM, Type MPL Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—125 HP, 1170 RPM, G.E.
1—100 HP, 625 RPM, G.E.
1— 80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1— 75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.

MOTORS—D.C. 230 VOLTS (Con't.)

8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—30 HP, 750 RPM, G.E., Type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
1—15 HP, G.E., 800 RPM, Type RC-11.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—60 HP, 500/1000 RPM, Diehl.
1—30 HP, 225/900 RPM, Crocker-Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
1—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—15 HP, 300/1200 RPM, G.E.
1—18/18 HP, 350/1200 RPM, Electro Dynamic.
3—11½ HP, 500/1500 RPM, Westinghouse.
1—10 HP, 400/1600 RPM, Westinghouse.
1— 5 HP, 600/1200 RPM, General Electric.
1— 5 HP, 450/1800 RPM, Crocker Wheeler.
1— 5 HP, 400/1600 RPM, Diehl.
1— 5 HP, 225/900 RPM, Electro Dynamic.

MOTOR GENERATOR SETS

1—150 KW, 125 volt, Westinghouse, squirrel cage.
1— 75 KW, 125 volt, General Electric, squirrel cage.
1— 65 KW, 125 volt, Westinghouse, squirrel cage.
1— 20 KW, 600 volt, General Electric, squirrel cage induction motor.
2— 15 KW, 250 volt, General Electric, squirrel cage.

TURBO GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v. con.
1—200 KW, G.E., 3 ph., 60 cy., 220 v. cond.
1— 30 KW, 135 volt, Allis Chalmers non-condenser.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 2300 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis-Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis-Chal.

TRANSFORMERS

2—400 KVA, G.E., 4156-250/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—150 KVA, G.E., 33000/2300/4000 Y.
2—100 KVA, General Electric 2200/220/440 volt.
3—100 KVA, Westinghouse, 11,430/250 volts.
3—100 KVA, Westinghouse, 13200/250 volts.
3— 75 KVA, Westinghouse, 2200/220/110 volts.
3— 75 KVA, G.E., 13,500-750/440 volts.
1— 75 KVA, G.E., 3 phase, 4156Y—120/208Y.
2— 50 KVA, Pbgh., 7500/15000 volts-110/220 volts.
2— 15 KVA, G.E., 2300-115/230 volts.
2—100 KVA, G.E., 2400/240/480.

GASOLINE DRIVEN D.C. GENERATOR SETS

2—25 KW, 125 volt.
1—30 KW, 125 volt.

It's Hemphill for Power!

J. L. HEMPHILL & CO.

Electrical Engineering and Equipment

OFFICE AND WAREHOUSE:
1601 53rd STREET
PHONE NEW YORK—LONGACRE 5-3227

NORTH BERGEN, N. J.
PHONE NEW JERSEY—UNION 3-2600

Below BERGER OFFERS

Rebuilt and Sold with a Standard New Guarantee

ONLY PARTIAL LIST

TRANSFORMERS

1—200 KVA GE, type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—200 KVA GE, type H Form VD 4800/2400/480 volts, 1 PH. 25 cy.
1—100 KVA GE, type H Form KDD 11000/2600 volt, 1 PH, 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
3—75 KVA Gen. Elect. K.S. 1 ph. 60 cy. 2300/115/230 volts.

OTHER SIZES VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle, 3 phase, 450 R.P.M. with direct connected exciter.
200 KW, Westh. Unity Power Factor, 3 PH, 60 cyc. 220/440 900 R.P.M. with direct connected exciter.
150 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts, 600 R.P.M. Revolving field with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 with Rev. Field. and built in Exc.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.

FREQUENCY CHANGERS

30 KVA, Gen. Elect. type I.T.T. frame 526 P.F. 08—220/440 volts 3 Ph. 60 cy. to 240 volts 120 cycle Motor KT frame 526—3 Ph, 60 cy. 220/440 volts 1800 RPM.

ALL SIZES VOLTAGES AND CYCLES

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volt
350	Gen. Elec.	Sl. Rg. 3 Brg	I	375	400
200	Lincoln	S. R.	I. X. W.	500	440
100	West.	Syn. Stator and Rotor	H.R.	300	2200
100	Wagner	Sl. Rg.	BR	750	220/440
70	Gen. Elec.	Syn. Stator and Rotor	ATI	167	2200

3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
200	West.	Syn.-Dir. Con. Ex.	P. F. 08	900	220/440
200	Gen. Elec.	Syn.	ATI	514	4000/2300
200	Weghse.	Syn.	Dir. Con.Exc.	600	2300
150	Gen. Elec.	Syn. Stator and Rotor	ATI	400	2200
25	Gen. Elec.	Sq. Cg.	I. K. Vert.	720	220

230 Volt D. C. Motors

H.P.	Make	Type	Speed
75	Crocker Wh.	CCM25JA	700
60	Sprague	D — Comp. Wound	625
40	Fair. Morse	Ball BRG. Vert. Comp.	1740

125 Volt D. C. Motors

H.P.	Make	Type	Speed
60	Allis Chalmers	FB131-Comp. B. B. Pipe Vent.	1755

550 Volt D. C. Motors

H.P.	Make	Type	Speed
35	West.	SK 150 Shunt Int.	850

D. C. GENERATORS

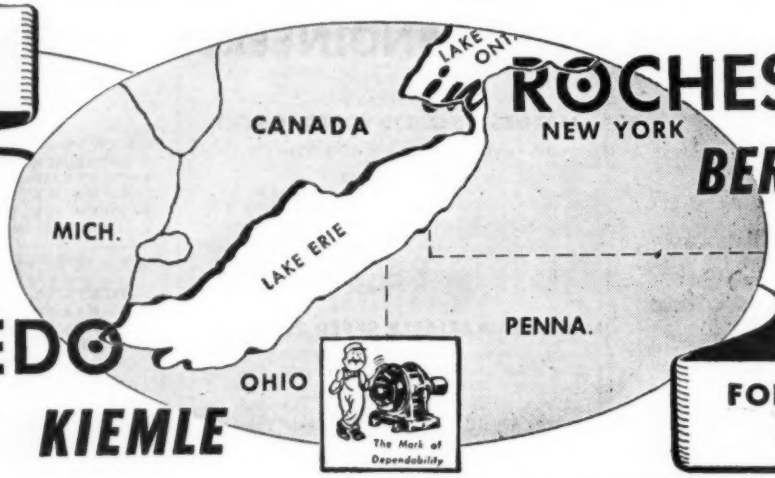
150 KW Western Elec. 3 brg. 3 wire, 115/230 V. 600 R.P.M.
50 KW—Northern—Comp. 110 V.—700 R.P.M.

OVER 10,000 STOCK ITEMS

THE FRED W.
KIEMLE CO.
33 N. SUPERIOR ST.
TOLEDO 4 OHIO

in TOLEDO

KIEMLE



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NEW YORK

BERGER

BERGER BROTHERS
ELECTRIC MOTORS, Inc.
395 STATE ST.
ROCHESTER 4
NEW YORK

FOR IMMEDIATE DELIVERY

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300 1 phase 25 cycle.
1—350 KVA, GE, type H-K.D.D. 2300/460—1 PH, 60 Cy.
3—150 KVA Gen. Elect. Type H 2300/230/460—1 PH. 60 Cy.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

10 K.W. Gen. Elect. 1 Ph. 60 Cy. 220 Volts—1800 R.P.M.

WEST. D.C.—VARIABLE SPEED MOTORS

10—10 H.P. Type S.K. 230 V, 500/1500 R.P.M. with Automatic Dynamic Braking Starters and Field Rheos.

SYNCHRONOUS—CONVERTER

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle 750 speed with transformers for 2300 volts to 230 volts D.C.

3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
500	Electric Mach.	Syn.	Stator and Rotor	257	440
200	Weghse.	Sl. Rg.	CW	600	220/440
150	Gen. Elec.	S. R.	I. M.	400	440
150	Gen. Elec.	Sq. Cg.	I.K.	600	2300
100	Gen. Elec.	S. C.	K.T.	720	440
100	Lincoln		M	1150	440
100	Gen. Elec.	R	MT.	600	440

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volts
150	Gen. Elec.	S. R.	IM	500	440
100	Allis Ch.	S. R.		750	440
75	Gen. Elec.	Var.	BTA	375/750	440
75	Gen. Elec.	S. R.	I. M. 17B	160	440
75	Gen. Elec.	Sl. Rg.	I. M.	750	220/440

230 Volt D. C. Motors

H.P.	Make	Type	Speed
150	West.	SK 180L Comp. Wd. Int.	1150
100	Northwestern	K30 Comp. Inter.	1750
75	West.	SK 150 Shunt	1200
50	Crocker Wheeler	CM	625

Rebuilt and Sold with a Standard New Guarantee

Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

Above KIEMLE OFFERS

REMEMBER "U.E.M." FOR THE FINEST IN POWER PLANT MACHINERY

Units listed available for immediate delivery

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

3125 KVA G.E. 180-200 lbs. pressure, 500° TT, 2300 volts, 3600 RPM, equipped with surface condenser, condensing auxiliaries, exciter unit, switchboard with instruments (a complete installation).

1875 KVA G.E. condensing 175-200 lbs. pressure, 500° TT 6600 volts, 3600 RPM complete with condenser.

1875 KVA (2) Westinghouse condensing, 200 lbs. pressure, 100° superheat, 480 volts, 3600 RPM complete with jet condensers and auxiliaries.

1250 KVA Westinghouse non-condensing, 250 lbs. pressure, 500° T.T., 15 to 25 lbs. gauge back pressure, 480 volts, 3600 RPM., complete with exciter, switchboard panel and instruments.

1250 KVA General Electric condensing, 300 lbs. pressure, 200°F. superheat, 4000 volts, 3600 RPM complete with surface condenser and auxiliaries.

1250 KVA Elliott condensing, 175-300 lbs. pressure, 240 volts, 3600 RPM complete with jet condenser and auxiliaries.

937 KVA G.E. condensing 150-175 lbs. pressure, 2300 volts, 3600 RPM with direct shaft exciter, surface condenser and auxiliaries.

780 KVA Westinghouse non-condensing 175-200 lb. pressure, 15 lb. back pressure, 480 volts, 3600 RPM, complete with switchboard.

625 KVA Westinghouse non-condensing, 150-200 lbs. pressure, 35 lbs. gauge back pressure, 2300/480/240 volts complete with switchboard.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

125 KVA Westinghouse non-condensing, 175-200 lbs. pressure, 0-10 lbs. gauge back, 240 volts with direct connected exciter and switchboard.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle

Alternating Current

900 KVA Allis Chalmers, 480 volts, 150 RPM generator direct connected to 24" x 36" Filer Stowell semi-Unaflow engine.

312 KVA Elliott, 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17"x24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

312 KVA Westinghouse 240/480 volts, 200 RPM generator direct connected to Skinner Unaflow non-condensing engine.

200 KVA Crocker-Wheeler, 240 volts, 400 RPM generator direct connected to Ames vertical Unaflow engine.

188 KVA Crocker-Wheeler, 208/120 volts, 225 RPM generator direct connected to 17" x 18" Skinner counterflow engine, 135 lbs. pressure, 5 lbs. back pressure. Complete installation.

156 KVA General Electric, 240 volts, 225 RPM generator direct connected to Nordberg Unaflow engine.

125 KVA General Electric, 240 volts, 257 RPM generator direct connected to 17" x 16" Skinner Unaflow engine, 100 to 130 lbs. pressure, 5 lbs. back pressure.

93.8 KVA General Electric, 240 volts, 257 RPM generator direct connected to 13" x 15" Skinner Counterflow engine, 100 to 130 lbs. pressure, 5 lbs. back pressure.

SPECIAL OFFERINGS

1690 C.F.M. 110 lb. air pressure Ingersoll-Rand steam driven air compressor 125 to 150 lbs. steam pressure.

1590 C.F.M. 100 lb. air pressure Hardie-Tynes steam driven air compressor 150 to 175 lbs. steam pressure.

500 KVA G. E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

ENGINE-GENERATOR UNITS

Direct Current

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to Ames vertical Unaflow non-condensing engine.

125 KW 125 volt, 250 RPM generator direct connected to 18" x 16" Elliott engine, 100 lb. pressure, 10 lb. back pressure, complete with switchboard.

75 KW 125 volt, 1800 RPM Westinghouse non - condensing turbine - generator unit.

75 KW 125 volt, 2400 RPM Allis Chalmers Terry non-condensing turbine-generator unit.

15 KW (3) Crocker-Wheeler, 125 volts, 410 RPM generators each direct connected to an American Blower vertical engine.

FREQUENCY CHANGER SETS

750 KVA Westinghouse, 3-phase, 60 cycle, 2300 volts alternating current generator direct connected to 910 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

1200 KVA General Electric, 3 phase, 60 cycle, 2400 volts alternating current generator direct connecting to 1700 HP, 3 phase, 25 cycle, 2300 volt, 300 RPM synchronous motor.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

DEPENDABLE ELECTRICAL EQUIPMENT

Guarantee

Rebuilt equipment in accordance with specifications as quoted is sold by us completely and thoroughly shop reconditioned, tested and guaranteed for a period of one year from date of shipment, when operated under normal load, usage and conditions with proper care and competent supervision. Any mechanical or electrical parts proving defective under normal operation will be repaired or replaced (at our option) by us, f.o.b. our plant, New York, N. Y. We are not responsible for consequential losses or damages outside of this equipment nor for repairs or replacements made by others without our written authorization. Correction of defects by repairing or replacing by us shall constitute fulfillment of all our obligation to the purchaser.

1 YEAR!

SQUIRREL CAGE MOTORS
3 ph. 60 Cy.

Qu.	HP	Make	Type	Speed
1	200	G.E. 440 v.	IK	600
1	147	West 25 cy.	CS	715
1	100	Al. Ch.		690
1	100	West.	CS	690
2	100	G.E. 440 v.	PTA56	375/750
1	85	G.E. 2300 v.	PT529	3600
1	75	El. Dy.	KNX505	1750
1	75	Burke		1150
1	50	G.E.	KT537	1750
1	50	Star	A75	1750
1	50	West.	CCL	1150
1	50	Al. Ch.		865
1	50	Cr. Wh.		865
1	50	Burke		690
1	50	West.	CS	580
2	45	W.E.		150/900
1	40	West.	CS	1760
4	40	El. Dy.	DNX444	1760
1	40	G.E.	KT	1150
1	40	Lincoln		1150
1	35	Wagner		850
1	35	West.	CS	690
1	30	U. S. Vert.	CPU907	3450
1	30	A-C		1150
1	30	Diehl		860
1	30	Cr. Wh.		870
1	30	Al. Ch.		870
1	30	G.E.	KT342	690
1	30	West.	CCL	690
1	30	G.E.	IK	514
1	25	Triumph		1750
1	25	G.E.	KT302	1750
1	25	Wagner 220v.	F-W	1200
1	25	Al. Ch.		1150
1	25	West.	CS	1150
1	25	El. Dy.	KMQ444	865
2	25	G.E.	IK	865
2	25	Diehl	IS167	865
1	25	West.	MS	860
1	25	Wagner 440v.	P-W	720
125/12½		G.E.	445	840/405
1	20	West.	CS365	3500
1	20	G.E.	PT312	1740
1	20	G.E. Vert.	PT501	1750
9	20	El. Dy.	KNX364	1750
1	20	F.M.	KMV12D	1150
2	20	G.E. Vert.	KT512	1150
1	20	Cr. Wh.		1150
1	20	F.&M.		1160
2	20	West.	CS	1160
1	20	G.E.	KT332	1160
2	20	Al. Ch.		860
1	20	F.M.		860
1	20	Diehl		860
1	20	West.	CS566	870
1	20	G.E.	KT326	870
1	20	G.E.	IK	690
1	20	West.	CS584	690
1	20	West.	CCL	690
1	15	West.	CS324	3500
2	15	G.E.	KF751	3400
1	15	Burke		1750
1	15	Wagner 220v.	P-W	1800
21	15	El. Dy.	326	1750
1	15	Lincoln		1150
1	15	G.E. Vert.	KT502	1150
1	15	West.	CCL	1150
3	15	West.	MS	1150
1	15	West.	CS	1150
1	15	G.E. Vert.	IK	860
1	15	West.	CS	860
1	15	Wagner 440v.	F-W	720
1	15	G.E.	IK	720
1	15	West.	CS504	415
3	10	G.E.	KT	3600
1	10	Cr. Wh.	Gr.Hd.	400
12	15	West.	CS 445	600/900 1200/1800

SQUIRREL CAGE MOTORS
2 ph. 60 cy. type

Qu.	HP	Make	Type	Speed
1	75	G.E.	IQ	1750
1	70	G.E. Synch.	AQI	1200
1	50	Lincoln		870
1	50	G.E.	IQ	870
1	40	Al. Ch.		870
	40	F-M		870
1	35	Al. Ch.		870
1	30	West.	CCL	1150
1	25	G.E.	KQ312	1750
3	25	G.E.	ICL	1150
1	25	West.	CCL	1150
1	25	Burke		900
1	20	West.	CS	1160
1	15	F-M		1750
1	15	G.E.	KQ502	1150
1	15	West.	CS4	1150
1	15	G.E.	IQ	720

SLIP RING MOTORS
2 & 3 ph. 60 cy.

Qu.	HP	Make	Type	Speed
1	450	G.E.	MT412	506
1	250	G.E.	IM	580
1	150	El. Dy.	New	1770
1	100	G.E.	MTC5546	800
1	100	G.E.	IM	900
1	100	G.E.	IM	690
1	100	F-M	FA	690
1	75	G.E.	IM	1160
1	75	West.	RF	1160
1	75	Al. Ch.		865
1	75	Al. Ch.	ANY	575
1	65	G.E.	MTC552	585
2	60	Otis		1750
1	60	West.	CW648	1150
1	60	West.	CW950A	290
1	50	G.E.	Ig	870
1	50	Wagner		1150
1	40	F-M		870
1	40	West.	CW	870
1	35	Burke		690
1	40	G.E.	MT312	570
1	30	G.E.	MC332	870
2	30	G.E. 220v.	MT542	690
1	25	West.	CW	1160
1	25	Louis Allis		1750
2	25	Al. Ch.	ANY20G	870
1	25	Burke	FMV3	870
1	25	Howell	SFS420	870
1	25	West.	CW748	575
2	15	G.E.	MT502	1150
1	15	West.	CW	870
1	15	Cleveland	MW147	870

A. C. GENERATORS

Qu.	Kw	Make	Voltage	Speed
1	150	G.E.	220/440	600
1	150	Cr. Wh.	220/440	900
1	100	West.	220/440	600
1	35	Allen	220/440	900
1	35	Burke	220/440	720
1	50	Elec. Mchy.	220/440	900
1	25	West. 1 ph.	110/220	1200

A.C. TURBO GENERATOR

625 KVA Westinghouse Geared Turbine, 150 lbs., 35 lbs. back pressure 3 ph. 60 cy. 2400 Volt .8PF also driving

D.C. TO A.C. GENERATORS

1—2½ KVA Janetter 115 V. D.C. to 115 v 60 cy 1 ph.
1—2½ KVA Continental 230 V. DC to 115 v 60 cy 1 phase
1—4 KVA Hertner, 115 v. DC to 115 v. 60 cy. 1 phase
1—7½ KVA Century 115 v. DC to 115 v. 60 cy. 1 phase
1—7½ KVA Elec. Spec. 115 v. DC to 3 ph. 60 cy 440 v.

230 V. D.C. MOTORS

Qu.	HP	Make	Type	Speed
1	350	West.	SK	340/425
1	150	West.	S	600
1	60	G.E.	LC	450/1160
1	60	El. Dy.	258	450/900
1	50	El. Dy.		900
1	50	West.	SK150	550/1100
1	45	Diehl		850
1	40	G.E.	DLC	1050
40	40	Cr. Wh.	CCM	915
1	35	West.	SK	1150
1	35	West.	SK120	975
1	35	G.E.	PLC204	440/880
2	35	West.	SK160	400/600
2	30	G.E.	CD83	3450
1	30	G.E.	RC	1150
1	30	West.	SA	975
1	25	G.E.	RC	1150
1	25	West.	SK	1150
1	25	Diehl	K8	850
1	25	Louis Allis	Encl.	900
1	25	Al. Ch.		850
1	25	El. Dy.		1500
1	25	G.E.	CD113	575
1	20	G.E.	CD83	1200/1600
1	20	R. & M.		1150
1	20	G.E.	RC	1150
1	20	El. Dy.		950
1	20	G.E.	RC	800
1	20	West.	SK110L	750
1	15	Roch.	SV5	3450
3	15	G.E.	RC	1150
2	15	G.E.	CD	1150
1	15	G.E. Vert.	CD	900
1	15	West.	SK	850
1	15	G.E.	RC	850
1	15	West.	SK	600/2500
13		Diehl		200/247
1	10	G.E.	RF	450/1800
1	10	G.E.	CD	1150
1	10	West.	SK	400/1200
3	10	G.E.	RC	850
1	10	G.E.	CVC	700
1	10	Diehl		750
1	10	West.	SK	600/1200
1	10	El. Dy.		450/1800
1	10	G.E.	RF	400/1600
2	10	West.	SA	400/1200
1	10	G.E.	RF	450/1800
1	8½	Diehl		900
1	8½	West.	SK	850
1	8½	West.	SK90	350/1400
1	8	G.E.	RLC	500/1500
1	7½	G.E.	RC	1700
1	7½	G.E.	CVC	1525
1	7½	West.	SK	1450
3	7½	G.E.	RC	1150
2	7½	G.E.	RC	1150
1	7½	West.	SK	950
1	7½	Al. Ch.		850
1	7½	G.E.	RC	850
3	7½	G.E.	RF	600/1800
1	7½	El. Dy.		550/1650
1	7½	Watson		525/1150
2	7½	G.E.	RF	450/1800
1	7½	West.	SK	450/1600
1	7½	Al. Ch.		350/1050
1	3	West.	Gr. Hd.	12½

110 V. D.C. Motors

Qu.	HP	Make	Type	Speed
1	90	G.E.	DLC65	900
1	30	G.E.	CD	1150
1	15	EK		1000
1	15	El. Dy.		615/1230
1	10	El. Dy.	3S	1100
1	10	West.	SK	850
1	10	El. Dy.	7½S	425/1275
1	10	Diehl		230
1	7½	Cr. Wh.		900
1	7½	West.	SK	500
1	7½	El. Dy.	5S	450/900
2	7½	El. Dy.	5S	600/1200

D.C. GENERATORS

KW	Make	Volts	Amps	Speed
300	West.	250	1200	900
250	G.E.	125	2200	720
100	West.	250	400	720
100	Al. Ch.	250	400	570
100	G.E.	125	800	1150
50	G.E.	250	200	870
50	G.E.	125	400	1150
45	El. Prd. 6/12		7500/3750	400
40	El. Dy.	250	160	1150
30	Reliance	250	120	1750
30	West.	125	240	1160
30	El. Dy.	600	50	1150
30	Har.	60	500	1150
25	West.	125	200	1150
25	El. Mchy. Syn.	125	200	1200
25	G.E.	250	100	1150
20	G.E.	125	160	1150
20	West.	250	80	1150
15	Burke	125	120	900
15	G.E.	250	60	1150
10	Al. Ch.	125	80	1150
10	G.E.	250	40	1150
7½	West.	250	30	1150
7½	G.E.	125	60	1150
5	G.E.	250	20	1150
5	West.	125	40	1150
5	G.E.	600	9	1750

15—100/125 Amp. 7½ Volt D.C. Generator 3 ph. 60 cy 220/440 Volt Motors.

SPECIAL ELECTRONIC Speed Regulated Motor Drive

300 KW West. SK 250 Volt D.C. Generator 900 RPM. with 350 HP West. SK 250 V. D.C. Motor, double end shaft, speed 0 to 600 RPM. Complete with Pilot Generator, all control and necessary 4 unit Motor Generator exciters.

COOLANT PUMPS

50—New Ruthman (Gusher) Coolant pumps, with ¼ H.P. 3 ph. 60 cy. 220/440 Volt Motors.

800 & 400 Cycle Generators

3—1 KVA Holzer Cabot 3 ph. 60 cy. 220/440 V.
2—1 KVA—800 cycle.

THIS IS A PARTIAL LIST ONLY!

NEW YORK CITY'S LARGEST STOCK OF ELECTRICAL MACHINERY

L. J. LAND & COMPANY

ESTABLISHED 1910

146 GRAND ST., NEW YORK 13, N. Y. CAnal 6-6976

Branch Offices:
10th & Exeter Streets, Reading, Penna.

"BIG STUFF" *is no problem to* BELYEA

In the Belyea Shops we have facilities to dismantle, re-nu-build, test and ship the biggest type of electric power equipment (as well as the smallest). It is facilities such as ours (the result of 37 years service) that materially lower the cost of rebuilding, testing and handling. Thus the price you pay for GUARANTEED Belyea Re-Nu-Built equipment always represents the utmost value for every dollar invested.

3—1667 K.V.A. PITTSBURGH TRANSFORMERS 13200 to 2300 volt, 1 phase, 60 cycle, just recently shipped from Jersey City to customer. A duplicate bank is still available here.

Part list of Belyea Equipment—Successful Operation Guaranteed

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1500 KW G.E., 250/275 V. D.C. to 2100 H.P., 2300 V.
1—1000 KW G.E., 250/275 V. D.C. to 1400 HP., 2300/4150 V.
1—1000 KW Whse., 600 V. D.C. to 2000 KVA, 2200 volt with exciter.
1—750 KW Whse., 275 V. D.C. to 1100 H.P., 2200 volt with exciter.
1—500 KVA—300 KW—220/440 V. A.C. Gen. to 500 H.P.—230 V. D.C. Motor.
1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.
1—288 KVA Whse., 440 V. A.C. Gen. DC to 304 H.P. —115 V. DC Motor.
1—240 KW Whse., 125 V. DC Gen. DC to 360 HP —440 V.
1—200 KW G.E., 125 V. D.C. to 300 KVA, 440 V. Syn. Motor with exciter.
1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 2300/4000 V.
1—50 KW G.E., CD 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

3 Phase 25 Cycle

1—25 KW G.E., 125 V. D.C. to 35 H.P., 360 V. Motor.
1—75 KW Whse., 125 V. D.C. to 110 H.P., 440 V. Motor.
1—250 KW G.E., 250 V. D.C. to 285 KVA, 6600 V. Motor.

TRANSFORMERS—POWER AND DISTRIBUTION

60 CYCLE (Unless Otherwise Noted)

Qu.	KVA	Make	Ph.	Type	Voltages
3	1667	Pitts.	1	OISC	13200x2300
1	1050	G.E.	3	WCTH	11000x445/222½
4	525	G.E.	1	HJ	2300x445
4	500	Pitts.	1	OISC	13200x2300
2	333	Pitts.	1	OISC	2400x220
3	333	Maloney	1	C	22000/11000x2300/575
2	333	Whse.	1	OISC	2300x460
3	300	G.E.	1	HRP-25 cy.	13200x575/1150/2300
1	300	Pitts	3	OISC	4150x208/120
3	200	G.E.	1	HLLD	27600x115/460
2	200	G.E.	1	HKDD	13800x220/440
1	200	Whse.	1	SK	6600x220/440
3	200	G.E.	1	HJ	2300x408/204
1	200	G.E.	2–3	Auto	2500x2500
1	200	G.E.	1	H	2300x115x230
3	100	G.E.	1	HJDD	13200x445/226
3	100	Whse.	1	OISC	13200x250
1	100	Whse.	1	OISC	11430x250
2	100	G.E.	1	A	2200x120/240
1	100	Whse.	1	SK	2300x115/230
2	100	Pitts.	1	OISC	2300x115/230

A.C. MOTORS

3 Phase 60 Cycle

SLIP RING

Qu.	HP	Make	Volts	RPM	Desc.
1	100	G.E.	2200	575	IM
1	100	G.E.	550	685	MTC-5552
1	100	G.E.	550	720	IM
1	100	G.E.	2200	1750	IM
1	100	G.E.	220	1750	IM
1	150	Whse.	2200	580	CW
1	150	G.E.	4000	585	IM-16
1	200	Al. Ch.	440	505	
1	250	Whse.	440/2300	450	CW
1	250	G.E.	4000	257	MT-424Y
1	350	G.E.	4000/2200	253	MT-442Y
1	350	G.E.	550	390	MT-412Y
1	400	G.E.	2200	252	IP
1	400	A.-C.	2300	505	ANY
1	450	Whse.	2200	875	CW
1	500	Al. Ch.	2200	590	ANY-36
1	600	Cr. Wh.	2200	507	131-AQ
1	800	A.-C.	400	885	ANY
1	1200	C. W.	2300	237	801Q

SQUIRREL CAGE

Qu.	HP	Make	Volts	RPM	Desc.
1	100	Whse.	2200	880	CS
1	150	Whse.	550	400	CS-594A
2	175/112	G.E.	440	900/720	IK
2	200	G.E.	2300	1175	11C
1	200	G.E.	2200	490	IK
1	200	G.E.	550	580	IK
1	300	G.E.	440	900	IK
1	300	Whse.	550	580	CS

SYNCHRONOUS

Qu.	HP	Make	Volts	RPM	Desc.
1	75	G.E.	220	600	TS 7556
1	600	Al. Ch.	2300	720	
2	2100	G.E.	2200/4400	514	ATI

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed	Desc.
1	750	G.E.	220/440	900	ATI
1	2000	Whse.	2300	720	
2	2100	G.E.	2300/4600	514	ATI
1	3000	Al. Ch.	2300	900	
1	5000	Whse.	2300/4000	900	

3 Phase 25 Cycle

1	75	Al. Ch.	440	750	ANY
1	150	G.E.	440	500	IM
1	200	G.E.	440	242	Sl. Rg.
1	300	G.E.	440	290	Sl. Rg.
1	390	G.E.	6600	750	ATI
1	1400	G.E.	2300	500	ATI

ROTARY CONVERTERS

3 Phase 60 Cycle

Qu.	HW	Make	Speed	Dc V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	Whse.	720	250	22000
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
2	300	G.E.	1200	600	2300
1	300	Al. Ch.	1200	250	2400

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500/225/275/13200/6600
1	500	G.E.	750/225/275/13200/6600

All units can be furnished with AC and DC controls

D.C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
2	1250	G.E.	MPC	500	180
1	1200	Whse.	Int.	600	600/720
1	1200	G.E.	MPC	600	450
1	800	G.E.	MPC	550	600
2	625	G.E.	MPC	500	130
1	500	Whse.	Int.	250	250/720
1	500	G.E.	MPC	230	900
1	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	250	Al. Ch.		230	525
1	200	Whse.	SK	230	400
1	175	Whse.	SK	230	150/525
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625
1	100/150	Whse.	SK-200	550	600
1	100	G.E.	LC-50	230	1200
1	100	Whse.	SK-180	230	600
1	75/100	Whse.	SK-183	230	450/900
1	50/100	G.E.	MPC	230	225/450
2	75	Whse.	SK-183	230	500/1000
1	75	G.E.	C	230	500/1000
1	60	El. Dy.	258	230	525/1050
1	50/60	Cr. Wh.	CMC-65H	230	500/1000
1	50	G.E.	RC-19	230	400/1200
1	50	Cr. Wh.	CMC-80H	230	380/750
1	15/50	Cr. Wh.	CMC-81H	230	300/900
3	40/50	G.E.	CD-12388	230	400/1600
4	25/30	G.E.	CD-11368	230	400/1600

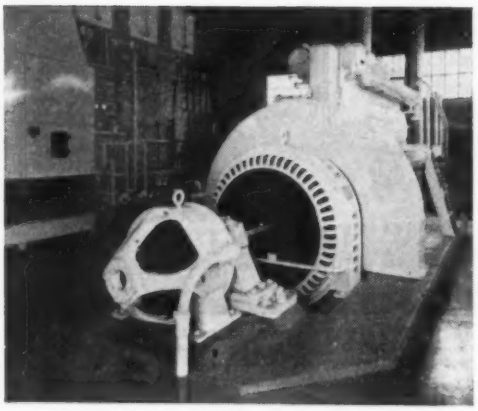
SUCCESSFUL OPERATION GUARANTEED
Quality without Question

BELYEA CO., INC.
Main Office and Shop
43 HOWELL ST., JERSEY CITY, N.J.

RE NU BILT BELYEA MOTORS

DIESELS

One or all Today

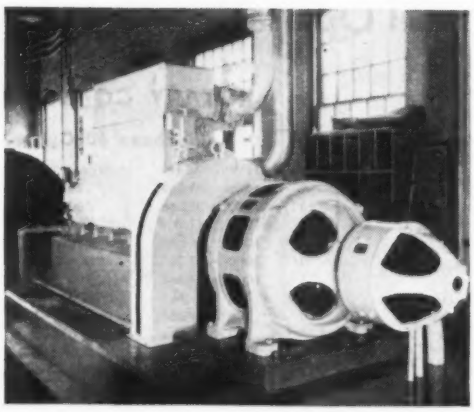


NEW IN 1938.

375 HP McIntosh Seymour 5B25 solid injection—5 cylinder—12½"x18"—4 cycle—360 RPM

direct connected to

312.5 KVA Westinghouse generator—3/60/240—with exciter, switchboard and synchronizer.

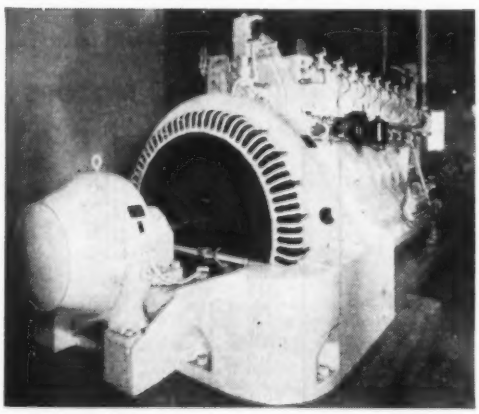


NEW IN 1937.

150 HP National Superior type VDMB—4 cylinder—9"x12"—4 cycle—solid injection—514 RPM

direct connected to

125 KVA Westinghouse generator—3/60/240—with exciter, switchboard and synchronizer.



NEW IN 1937.

330 HP General Motors (Winton) Model 1920—8 cylinder—10"x14"—4 cycle—solid injection—400 RPM

direct connected to

282 KVA General Electric generator 3/60/240—with exciter, switchboard and synchronizer.

This fine plant which may be inspected in operation is unusually complete, including Buffalo evaporative coolers for closed system jacket water cooling with all necessary auxiliaries.

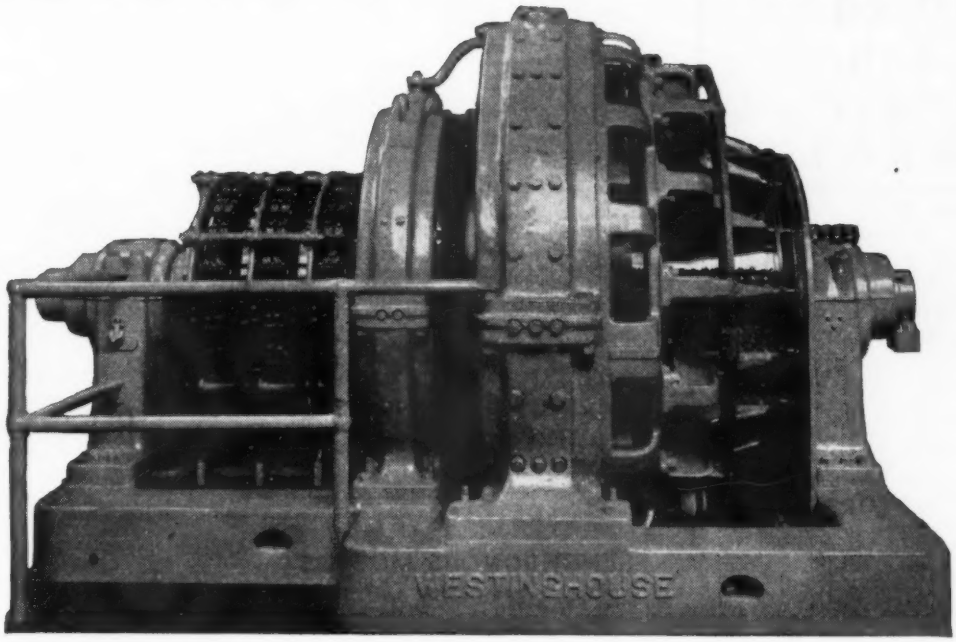
The above plant is just one of several attractive diesel offerings we have available at this time.

ROBERT SCHOONMAKER

Port Washington, Long Island, N.Y.

Phone Roslyn 1220

ELECTRICAL POWER MACHINERY



Actual Photograph

2250 KW WESTINGHOUSE ROTARY CONVERTER

2250 KW (2) Westinghouse self-starting synchronous rotary converters, 125-250 volts, 3-wire, or 235-300 volts 2-wire, 9000 amps. direct current; 6 phase 60 cycle alternating current, 450 RPM, equipped with 3075 Westinghouse transformers, 3 phase 60 cycle 13200 volts primary.

STEAM TURBINE GENERATORS

3 phase 60 cycle

7500 KVA General Electric condensing turbine generator unit, 2300/4000 volts, 250 lbs. steam pressure, with surface condenser.

2500 KVA Westinghouse condensing turbine generator unit, 2300 volts, 200 lbs. steam pressure, with surface condenser.

1875 KVA Westinghouse automatic extraction type condensing turbine generator unit, 480 volts, 175-200 lbs. steam pressure, 0-20 lbs. extraction pressure, with surface condenser.

1563 KVA Allis Chalmers-Kerr non-condensing turbine generator unit, 2300 volts, 150-200 lbs. steam pressure, 0-15 lbs. back pressure.

1250 KVA Allis Chalmers automatic extraction type condensing turbine generator unit, 480 volts, 150 lbs. steam pressure, 0-15 lbs. extraction pressure, with surface condenser.

STEAM ENGINE GENERATORS

3 phase 60 cycle

750 KVA General Electric generator, 2300 volts, direct connected to Filer & Stowell uniflow engine, 180 lbs. steam pressure, 5 lbs. back pressure.

480 KVA General Electric generator, 480 volts, direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure.

312 KVA General Electric generator, 2300 volts, direct connected to Chuse Corliss engine, 150 lbs. steam pressure, 10 lbs. back pressure.

260 KVA Western Electric generator, 240 volts direct connected to Skinner uniflow engine, 175 lbs. steam pressure, 5 lbs. back pressure.

156 KVA General Electric generator, 2300 volts, direct connected to Skinner uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure.

STEAM ENGINE GENERATORS

250 volts Direct Current

600 KW Crocker Wheeler generator, 250 volts, direct connected to Skinner vertical uniflow engine, 150 lbs. steam pressure, 5 lbs. back pressure.

300 KW Westinghouse generator, 250 volts, direct connected to Skinner uniflow engine 150 lbs. steam pressure, 5 lbs. back pressure.

250 KW Crocker Wheeler generator, 250 volts, direct connected to Skinner uniflow engine, 125 lbs. steam pressure, 5 lbs. back pressure.

MOTOR GENERATOR SETS

250 volts Direct Current

1000 KW General Electric generator 250 volts, direct connected to 1400 HP General Electric synchronous motor, 3 phase 60 cycle 2300 volts, 514 RPM

1500 KW Allis Chalmers generator, 250 volts, direct connected to 2100 HP Allis Chalmers synchronous motor, 3 phase 60 cycle 13,200 volts, 514 RPM

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. **Telephone: MAin 9514** **CLEVELAND 14, OHIO**

WAGNER

"Certified Rebuilt" ELECTRICAL APPARATUS

M-G SETS

300 KW Gen. Elec. type MPC gen. DC 170 volts 1760 amp. coupled to 450 HP G.E. MPC motor DC 250 V. 1150 RPM (can furnish A.C. drive).
150 KW Allis-Chalmers gen. DC 250 volts, coupled to 250 H.P. Gen. Elec. Synch. motor, 3-60-220/440 volts.
100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage I-K motor 3-60-2200/4000 V.—1200 RPM.
50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440 V. 1800 RPM.
35 KW Gen. Elec. DLC gen. DC 250 V. to 50 HP AC motor 3-60-220/440 V.
30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1160 RPM, late style 3 brg. unit.
19 KW Gen. Elec. CD95 gen. DC 65 V. 300 amp. to 30 HP G.E. KT motor 3-60-220/440 V.

Others available—special units built to order

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
100	Northw'n	interpole	230	1700
100	Reliance	1050T	230	500/1200
100	Sprague cradle dynamometer		250	1650/2500
50	G.E.Sprague (2)	LC	250	700/2000
50	Whse.	SA	230	450/1350
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
40	Whse. (2)	SK158	230	575
30	Sprague	LC	230	600/1200
30	Sprague	dynamom	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
20	Gen. Elec.	DLC	230	500/1500
20	Fair Morse	TR	230	325/700
20	Whse.	SK	230	850
20	Whse.	SK111	230	250/1000
15	Whse.	SK80	230	1150
15	Gen. Elec.	LC	230	550/1100
15	Gen. Elec.	CD83	230	1150
15	Whse. (6)	SK90	230	850

QUICK SHIPMENT FROM STOCK

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	150	Whse. New b. b.	C8771.18	1800
1	150	Whse.	CS	900
1	100	Allis Ch.	AN	900
1	100	Gen. Elec.	I-K	720
1	75	Whse.	CCL	720
1	75	Gen. Elec.	I-K	600
1	75	Allis Chal.	AN	720
1	50	Gen. Elec. New	K405	1800
1	40	Gen. Elec. New	K404	1800
2	40	Allis Ch.	AN	1200
1	40	Howell 440 v.	SCBB	3600
1	40	Allis Ch.	AN	720
1	40	Gen. Elec.	I-K	1200
1	40	Gen. Elec.	KT332	1200
2	30	Allis Ch.	AN	1200
1	30	Allis Ch.	AN	600
6	30	Allis Ch.	AN	900
2	30	Allis Chl	AN	720
2	30	Gen. Elec.	KT326	1200
1	25	F. Morse b. b.	H12A	1200
2	25	Allis Ch.	AN	1200
1	25	Gen. Elec.	KT322	1200
2	25	Allis Ch.	AN	900
1	25	Allis Ch.	AN	600
1	25	Whse. New	C8405	1200
6	20	Whse. New	C8364	1800
1	20	Wagner	17TBW	1800
2	20	Gen. Elec.	I-K	1200
3	20	Whse.	CS	900
1	20	Ideal	AA	1200

25 CYCLE MOTORS

H.P.	Mfr.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
300	Whse.	CW sl. rg.	500
150	Whse.	HD sl rg.	500
150	Gen. Elec. 2200 v.	MT359 sl. rg.	1500
100	Whse.	CCL sq. cg.	500
100	Gen. Elec.	I-K	750
50	Allis Ch.	ANY sl. rg.	1500
25	Gen. Elec.	I-K	1500

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
350	Gen. Elec. 3 brg.	ATB	220/440	600
300	Whse.	ped.	220/440	900
250	G. E. 1-brg.	ATI	220/440	600
190	Gen. Elec.	ATB	220/440	600
150	Gen. Elec. 3 brg.	TRB	220/440	450
60	Gen. Elec.	TS		900
50	Burke		220/440	1200

CENTRIFUGAL PUMPS

14" Foster Wheeler, 5000 gpm @ 45 ft.
10" Weinman, 2500 gpm @ 40 ft.
8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	400	G.E. 2200 v.	I-P	12
1	350	Allis Ch.	ANY	5
1	350	F. Morse 2200 v.	HV	6
1	300	Whse. 2200 v.	CW	7
1	300	Burke	EMV	2
1	200	Gen. Elec. 2200 v.	I-M	6
1	175	Lincoln	IXV	6
2	150	Allis Ch. 3 brg.	ANY	8
1	100	G.E. 2200 v.	I-E13A	18
1	100	Gen. Elec. 3 brg.	I-M	6
1	75	Gen. Elec.	MT556	7
1	75	G.E. 2200 v.	I-E13	18
1	75	Gen. Elec.	MT558	6
1	75	Gen. Elec. 2200 v.	I-M	9
1	65	P. & H. b. b. Int.	CA16	9
1	60	Whse. 2200 v.	CW657	18
3	60	Gen. Elec.	M-505	12
1	50	Gen. Elec.	MT536	12
1	50	Al. Ch. b. b. 2200 v.	ARY	6
1	50	Gen. Elec.	MT342	6
1	50	Gen. Elec.	I-M	6
1	40	Gen. Elec. 2 ph	MQ536	6
1	40	Northw'n	HW35A	12
2	40	Gen. Elec.	MT532	12
1	40	Fair Morse b. b.	HV	9
1	40	Whse.	CW	9
1	40	Watson b. b.	KHV	12
2	40	Allis Ch.	ANY	4
1	35	Fair Morse b. b.	HV	18
1	30	Northwestern b. b.	HW404	18
2	30	Allis Ch.	ANY	9
2	30	Whse. enclosed	MA	6

D. C. GENERATORS

KW	Mfr.	Type	Volts	Spe
250	Northern		250	
150	Allis Ch.		250	6
50	Cr. Wheeler	CC	125	18
40	Whse.	SK	250	7
35	Gen. Elec.	DLC	250	9
30	Lincoln b. b. 600 amp.		50	12
25	Gen. Elec.	DLC	125	9
25	Gen. Elec.	LC	250	9
20	Whse.	SK	250	12
19	Gen. Elec. 300 amp.	CD	65	12
16	Cr. Wheeler	CCD	125	6

ALSO IN STOCK . . . OIL SWITCHES BLOWERS & FANS . . . SPEED REDUCERS . . . 500 NEW MOTORS

60 CYCLE A. C. GENERATOR

KVA	Mfr.	Type	Volts	Spe
500	Gen. Elec. 3 brg.	ATB	2300	4
300	Gen. Elec. 3 brg.	ATB	240/480	6
300	Whse.	ped.	240/480	9
300	Elec. Machy. 3 brg.		240/480	7
250	Gen. Elec. 1 brg.	ATB	240/480	6
150	Allis Ch.		2300	3
125	Whse.	ped.	2300	2
100	Cr. Wheeler		240/480	6

ARTHUR WAGNER COMPANY

1436-38 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 7409

THE GLOW ELECTRIC COMPANY

933-943 HARRIET ST. Phone MA. 3024 CINCINNATI 3, OHIO

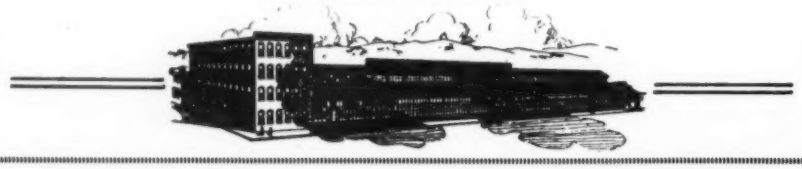
Solicits your inquiries for

AC & DC MOTORS —GENERATORS
SYNCHRONOUS MOTORS
MOTOR-GENERATOR SETS
STEAM ENGINE-GEN. SETS
SLIP RING MOTORS
CONTROL EQUIPMENT
PUMPS
ELECTRIC HOISTS

IN EXCESS OF 12,000 ITEMS ARE AVAILABLE, TOO NUMEROUS TO LIST.

WE BUY SURPLUS ELECTRIC EQUIPMENT

IN BUSINESS SINCE 1905



DIRECT CURRENT DIESEL PLANT

3—BUDA-LANOVA DIESEL GENERATING SETS, Model 6-LD909, 5¼ x 7, 6 cyl., 4 cy., 900/1150 RPM, direct connected to:

3—55/67.5 K.W. Star Ball Bearing Generators D.C. 110/230/250 volt, type S.C. 94, compound wound.

Including fully automatic panel boards, voltage regulator, Motor generator and balancing sets, transfer pumps, etc., also 230 volt set of Philco heavy duty Batteries 420 amps hr., practically new. This is one of the finest and most complete plants offered in some time. May be seen in operation.

ALJON ELECTRIC DIESEL CO.
151-55 Washington St., Brooklyn 1, N. Y.

GOOD VALUES—Always

Fairbanks Morse Diesels, 225, 240, 280, 360, 375, 420 HP. Also generators.
McIntosh Seymour complete diesel generator sets 1000 & 300 HP, 2 or 3 phase 60 cycle, 240, 440, 600 or 2300 volt generators.
DeLaVergne 260 HP Diesel Generator.
Busch Sulzer Diesels. 400, 500, 600 HP.
Boilers. 30 HP vertical to 800 HP in water tube types. 100 to 250 lbs. 2—80 HP H.R.T. in steel encased battery. 2—260 HP H.R.T. Now being reconditioned.
Derricks. 10, 20, 50 ton Guy & Stiffleg.
Steel Sheet Piling, Pile Hammers, etc.

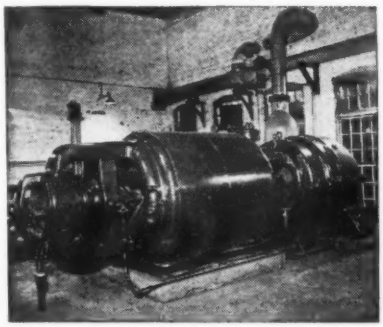
Mississippi Valley Equipment Co.
507 Locust St. St. Louis 1, Mo.

Extraordinary Liquidation

6 COMPLETE POWER PLANTS

Operated by the Georgia Power Company as recently as Dec., 1944

We are listing herewith excellent high-pressure power equipment which has just been released for sale. All this equipment has been maintained in excellent condition and is ready for immediate operation complete with all accessories. Included are all switchboards, motors, panels, transformers, motor-generator sets, exciters, automatic circuit breakers, compensators, rheostats, oil-switches, control-apparatus, pumps, blowers, heaters, piping and all auxiliary equipment. This machinery will move quickly and we urge that you arrange for immediate inspection at the premises.



GENERAL ELECTRIC 2,000 Kilowatt Turbo Generator. Actual Photo As of January 1945.

ATHENS, GA.

1—500 KW Westinghouse Turbo-Generator, 150# Steam Pressure, 2300 Volts, 3 Phase, 60 Cycle, 3600 R.P.M., with Westinghouse-LeBlanc Jet Condenser.
2—370 HP Sterling Water Tube Boilers.
2—390 HP Sterling Water Tube Boilers.
1—600 HP Babcock & Wilcox Water Tube Boiler.
1—300 KW General Electric Rotary Converter, Type HC, 8-300-900, Form P, 60 Cycles, Continuous Current, 600 Volt, 500 Amps., complete with Panel and Transformers.
1—Pawling & Harnischfeger Overhead Trolley Crane.
1—180' Steel Stack (approximate).

AMERICUS, GA.

2—375 KW Allis-Chalmers Turbo-Generators, 160# Pressure, 3600 R.P.M., 2300 Volts, 94.4 Amps., 3 Phase, 60 Cycle, with Wheeler Surface Condensers.
1—575 KW Allis-Chalmers Turbo-Generator, 160# Pressure, 2300 Volts, 157 Amps., 3 Phase, 60 Cycle, with Wheeler Surface Condenser.
1—Maris Bros. Overhead Crane.
2—200 HP Casey Hedges Water Tube Boilers, F-27-38 Foster Superheaters.
1—300 HP Heine Water Tube Boiler.
1—81' Steel Stack.

AUGUSTA, GA.

1—2750 KW General Electric Turbo-Generator, Steam Pressure, 150#, A.C. Generator, Type AQB, Class 4—Form HT, Speed 1800 R.P.M., 2300 Volts, 598 Amps., W. M. Kellogg Co. Twin Bulkley Injector Condenser.
3—400 HP Casey Hedges W T Boilers.
1—500 HP Casey Hedges Water Tube Boiler. Foster Superheater. These Boilers are Oil-Fired, system complete, Automatic Draft Control equipment, etc.

LANGSDALE, ALA.

1—2000 KW General Electric Turbo-Generator, 180# Pressure, 3600 R.P.M. Generator, Type ATB, 600 Volt A.C., 2403 Amps., with Westinghouse-LeBlanc Jet Condenser.
1—750 KW General Electric Turbo-Generator, 150# Pressure, Type ATB, Form HT, 600 Volts, 3600 R.P.M., with Westinghouse-LeBlanc Jet Condenser.
3—308 HP Heine Water Tube Boilers.
1—518 HP Heine Water Tube Boiler.
1—Overhead Trolley Crane—Maris Bros., 20 Ton.

For Further Details

TELEPHONE, WIRE OR WRITE US AT THIS OFFICE OR THAT OF OUR SOUTHERN ASSOCIATES

ATLANTA STEEL AND SUPPLY COMPANY

349 Decatur Street

Atlanta 3, Georgia

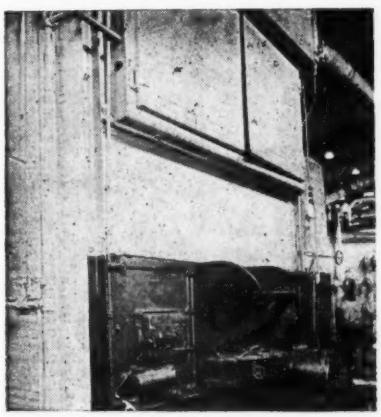
Telephone Walnut 9412 Main 4947

GRIFFIN, GA.

1—2000 KW General Electric Turbo-Generator, 2500 KVA, 6600 Volts, 219 Amps., 3600 R.P.M., Type ATB, Form HT, direct-connected Exciter with Elliott Jet Type Condenser.
1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3600 R.P.M., direct-connected Exciter, Wheeler Jet Condenser.
2—512 HP Babcock & Wilcox Water Tube, Sectional Type, 200# Pressure Boilers.

ALBANY, GA.

1—1000 KW General Electric Turbo-Generator, 150# Pressure, Type ATB-2, Form T, 2300 Volts, 314 Amps., 3600 R.P.M., with Worthington Barometric Condenser.
1—600 KW Westinghouse Turbo-Generator, 2300 Volts, 187 Amps., 3 Phase, 60 Cycle, 3600 R.P.M., with Worthington Barometric Condenser.
1—500 HP Sterling Water Tube Boiler.
1—250 HP Walsh & Weidner HRT Boiler.
2—250 HP R. D. Cole HRT Boilers.



Water Tube Boiler #7. 518 H. P. with Westinghouse Single Retort Underfed Stoker—200 lbs. pressure. Actual photo as of January 1945. Boiler—Heine

REPUBLIC TEXTILE EQUIPMENT COMPANY

REFINANCING - APPRAISAL - PURCHASE - SALE - LIQUIDATION OF MILL PROPERTIES
PURCHASE AND SALE OF USED MACHINERY

40 Worth Street, New York 13, N. Y. **Cortland 7-1591**

CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

MOTOR GENERATOR SETS

KW	Make	DC	Volts	AC Volts
1200	G.E.	280	Syn.	3/60/4100
1000	G.E.	250	Syn.	3/60/4150
1000	G.E.	600	Syn.	3/60/2300
1000	Wtg.	275	Ind.	3/60/4100
750	Wtg.	275	Syn.	3/60/440
400	G.E.	250	Syn.	3/60/2300
225	Ideal	125	Syn.	3/60/2200
200	Elliott	125	Ind.	3/60/2200
150	Al. Ch.	250	Syn.	3/60/2300
100	Al. Ch.	125	Syn.	3/60/440
100	Wtg.	250	Ind.	3/60/2200
100	G.E.	250	Ind.	3/60/2200
100	G.E.	300	Syn.	3/60/440
100	G.E.	300	Ind.	3/60/440
75	G.E.	250	Ind.	3/60/440
75	G.E.	125	Syn.	3/60/220
60	Al. Ch.	110	Ind.	3/60/2200
50	G.E.	250	Ind.	3/60/440
25	G.E.	230	Ind.	3/60/220
22½	G.E.	125	Ind.	3/60/220
15	Ideal	220	Ird.	3/60/220
10	G.E.	115/230		Balancer set
7½	G.E.	60	Ind.	3/60/440
7½	Jen	115/230		Balancer set
	Roth	125/250		Balancer set
3½	G.E.	230	Ind.	3/60/220
	Lincoln	115	Ind.	1/60/220
3	Lincoln	115	Ind.	1/60/220
3	Westg.	25	Ind.	3/60/220
2½	Acme	45	Ind.	3/60/220
2½	Wotton		Ind.	1/60/110/220
2.4	Lincoln	80	Ind.	3/60/220
3 HP	Roth	110	2 KVA	1/60/110
2	El Sp.	750	Ind.	3/60/440
1	Holtz. C	65		220 DC.
.5	Rob. M.	115		Variable voltage
.378	G.E.	110	Ind.	1/60/110
.250	Robbins	125	Ind.	1/60/125
.250	Roch.	120	Ind.	1/60/110/220
.2	G.E.	6		115 v.d.c
.2	G.E.	6	Ind.	1/60/110/220

FREQUENCY CHANGERS

1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph., 60 cy., 460 volt, 300 RPM, 1570 amps., 1250 KVA, 0.9 P F 50° synchronous motor with amort. wdg.; dir./conn. to 1000 KW General Electric type AT-10-1250M-300, 3 ph., 25 cy., 460 volts, 300 RPM, 1570 amps., 1250 KVA, 0.8 P. F. 50° A C generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter

(This is a three brg. unit suitable for operation from either end.)

SLIPRING MOTORS

3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
2	2500	G.E.	MT	253
1	1000	Westg.	CW	450
1	1000	Westg.	HR	360
1	1000	G.E.		400
1	850	Allis. Chal.		1180
1	800	Westg.	CW	360
2	800	Westg.	CW	507
1	800	Westg.	CW	900
1	750	Allis Chal.		440
1	750	G.E.	I-P	900
1	700	G.E.	MT-10	710
1	600	Westg.	with drive	350
1	600	West.	CW	390
1	500	G.E.	MT412	435
1	500	G.E.	MT412	450
1	450	G.E.	MT412	600
1	400	Westg.	CW	435
1	400	Allis Chal.		600
1	400	G.E.	I-M	720
1	400	G.E.		1200
1	400	G.E.	IP	1800
1	350	Allis Chal.		300
1	350	G.E.	MT	300
1	350	G.E.	I-M	900
1	300	G.E.	I-24	293
1	300	Westg.	CW	400
1	300	G.E.	I-P	450
1	300	Westg.	CW	500
1	300	G.E.	I	514
1	300	G.E.		720
1	250	Westg.	CW	435
1	250	Cr. Wheeler	SR27QB	600
1	250	G.E.	IM	435
4	100	Ideal	2200	690

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
1	1000	G.E. 2200 v.	K	509
1	700	G.E. 2200 drip-proof cons.	KF	1800
1	600	Fair Morse	H2	212
1	500	G.E.	IK	1200
1	500	Westg.	CS	1750
1	400	Allis Chal.		600
1	400	G.E.	I-M	950
1	400	G.E.	I-K	1800
3	250	Westg.	CS	350
1	250	Ideal	A	1200
1	225	G.E.	I-E	1800
3	200	A.C.	AR	3600
1	200	Allis Chal.	AN	347
1	200	Fair Morse		514
1	200	Westg.	CS	600
1	200	G.E.	IK	600
1	200	G.E.	KT566	720
3	200	G.E. 2200 v.		1800
3	200	Fair Morse	BB	1800
1	200	Westg.	CS	3600
2	200	G.E.	KTP	3600
1	150	Allis Chal.		570
1	150	G.E.	IK	600
1	150	Westg.	CS	1800
2	120	G.E.		720
2	150	G.E.	I-K	720
1	150	Allis Chal.		850
1	150	G.E.	K-558	900
1	150	Westg.	CS	1800
13	75	A.C.	AR	1800

DYNAMOMETERS

250 HP GE Sprague type C dynamometer, laboratory test type 250 volts 1200/1500 RPM with Scale beam & control panel, 50 HP G.E. Sprague block test type, 275 volts, 750/2000 RPM, with complete panel.

5—25 HP GE Sprague type LC shunt interpole, block test with control panels 825/2000 RPM.

1—Type TLC-110, 250 HP, 1000/2000 RPM 250 V. BB. All Complete.

SYNCHRONOUS MOTORS

HP	Make	Volts	Speed
600	G.E.	2200	600
500	G.E.	2200	720
500	G.E.	2200	450
300	G.E.	440	900
270	G.E.	440	600
190	E.M.	440	720
150	E.M.	440	1200
5	G.E.	220	1800

AIR COMPRESSORS

1—6x6 Chicago Pneumatic horizontal.

1—6x6 Gardner-Quincy 60 CFM 100# horizontal.

HOISTS

3—500 lbs. Cable type, 230 volt DC motors.

1—2000 lb. Detroit rope type hoist, 3/60/220 AC.

ARC WELDERS

2—300 amp Lincoln stable-Arc with bb motor 3/60/220 AC.

1—400 amp Lincoln stable-arc with bb motor 3/60/220 AC.

1—300 amp Unaweld with 3/60/220 AC bb motor.

CHICAGO ELECTRIC CO.

1320 W. CERMAK RD.
CANAL 2900

CHICAGO 8, ILL.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS

3 phase, 25 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	G.E.	KT327	750	1781884
15	Allis Chal.		720	84242
15	G.E.	I-K	750	685100
15	West.	CCL	1500	816324
20	West.	CS	715	2691183
20	West.	CS	730	1949877
15	Otis	15	750	104787V
20	Allis Chal.		720	3K28825
20	Wagner	BP22T	750	119028
20	Reliance		720	Z20194
25	Allis Chal.	AR20A	750	220-A-623-4209-3
25	G.E.	I4	750	292596
25	Rob. & Myers	K	720	P515362
25	Triumph	TR12	750	C14248
30	Wagner	22VBMS	710	127097
30	Wagner	22VBM3	725	171477
30	West.	CCL	710	602618
30	G.E.	KT327	1440	2302731
40	West. (2200 v.)	CCL	710	854121
38	Otis	AC	750/1871½	70062Y
38	Otis	AC	750/1871½	70061Y
40	Wagner	22TLBP	1425	318604
40	West.	CCL	710	1032102
50	G.E.	I-K	1455	4015021
75	West.	CS	735	2207524
100	G.E.	KT553	1500	4820366
100	West.	CCL	480	808349
150	G.E.	I-K	363	2246835
150	G.E.	I-K	365	2246834
150	G.E. (2200 v.)	KT557Y b.b.	1460	5227355
150	G.E. (2200 v.)	KT557Y b.b.	1470	5269756
150	G.E. (2200 v.)	KT557Y b.b.	1460	5227354
225	Elec. Mach.	(2200/440 syn.)	500	504129
1150	G.E.	ATI (syn.)	375	695425

MOTOR GENERATOR SET

1—125 KW Ridgeway 250 V. DC 1200 RPM, direct connected to 180 HP. Ridgeway Motor 3/60/440 Volts 1200 RPM DC. Panel and Starting Compensator.

FREQUENCY CHANGER SET

1—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM direct connected to Generator 362½/440 V. Complete with exciters and panels.

TRANSFORMERS

3—150 KVA General Electric Type 11, Form KS, 2400 Volts Primary 120/440 Volts Secondary.

REBUILT MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Crocker Wheeler		600	131413
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	944593
20	Westinghouse	CS	1200	2160590
20	Westinghouse	MS	1200	1056826
20	Westinghouse	MS	1200	1246745
20	Westinghouse	MS	1200	1056827
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	1930159
20	Westinghouse	CS	1800	2693044
25	Westinghouse	MS	1800	1562026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Armor	BB	720	4343
30	Crocker Wheeler		720	17270
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	General Electric	I-K	1800	68511
40	General Electric	I-K	1800	77017
40	General Electric	I-K	1800	73316
40	Westinghouse	MS	1800	1506800
40	Westinghouse	MS	1800	1051548
40	Westinghouse	MS	1800	1056802
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	Westinghouse	CS	1800	1949877
50	General Electric	14	1800	181444
50	Reliance		1800	Z20194
50	Allis Chalmers		1800	3K28825
60	Westinghouse	CS	900	4884402
60	Reliance		1200	B11458
60	General Electric	I	1800	2922596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
75	Westinghouse	CS	1800	2134671
100	Westinghouse	CS	900	2207524
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (2200 v.)

HP	Make	Type	RPM	Serial No.
125	General Electric	KT562	720	Ball bearing
125	Westinghouse	CS	1200	2318625
150	General Electric	KT568	450	
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	Westinghouse	CS	1200	4572596 (2200 v.)
150	General Electric	I-K	720	122809 (2200 v.)
150	Westinghouse	CCL	720	808349 (2200 v.)
200	General Electric	KT568	514	
200	General Electric	I-K	900	232917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	KT568	600	
250	General Electric	I-K	600	2246834
300	General Electric	KT568	720	
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845
400	General Electric	KT568	900	

SLIP RING MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
20	Westinghouse	CW644C	575	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	1558408
40	Westinghouse	CW748	690	4406823
40	Westinghouse	CW748	690	4406825
40	Westinghouse	CW748	690	4406821
40	Westinghouse	CW748	690	4406819
40	Westinghouse	CW748	690	4405824
250	Allis Chalmers	3 bearing	505	104390 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

MAGNETIC CONTACTOR

400 HP. Gen. Elect. Type CR. 7006. Form D12D. 3/60/440 Volts.

CURRENT LIMITING REACTOR

60 KVA. Westinghouse 1 Phase 25 Cycle 6.2% on 12000 Volt Lines.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. **BUFFALO, N. Y.** **CL. 4758**

THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.

1—15300 KVA Westinghouse Cond.
1— 7500 KVA General Electric Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 4000 KW General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 3125 KVA General Electric Extrac.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 750 KVA General Electric Cond.
1— 625 KVA General Electric Cond.
1— 625 KVA General Electric Non-C.
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

D. C. TURBO UNITS

1—1500 KW General Electric 250 V.
2—1000 KW General Electric 250 V.
1— 125 KW General Electric 125 V.
1— 75 KW General Electric 125 V.
1— 25 KW Westinghouse 125 V.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 375 KVA Skinner Uniflow
1— 375 KVA Harrisburg Uniflow
1— 350 KVA Ames Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 210 KVA Skinner Uniflow
1— 150 KVA Skinner Uniflow
1— 94 KVA Ridgway 4-valve
1— 93.8 KVA Skinner Uniflow

D. C. STEAM ENGINE UNITS

1—500 KW Ames Uniflow 250 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—250 KW Ames Uniflow 250 V.
1—150 KW Ridgway 4-valve 125/250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire

OIL & GAS ENGINE UNITS

1—625 HP Worthington, 240 V. 60 cy. gen.
1—520 HP Busch Sulzer, 2400 V. 60 cy. gen.
1—450 HP M.A.N., 2300 V. 60 cy. gen.
1—440 HP Nordberg, 250 V. DC gen.
1—375 HP Worthington, 240 V. 60 cy. gen.
1—375 HP McInt. & Sey., 240 V. 60 cy. gen.
1—320 HP Winton, 240 V. 60 cy. gen.
1—300 HP McInt. & Sey., 480 V. 60 cy. gen.
1—175 HP Sterling (gas), 480 V. 60 cy. gen.
1—150 HP Superior, 240 V. 60 cy. gen.
2—125 HP Winton, 240 V. 60 cy. gen.

WATER TUBE BOILERS

1—880 HP B. & W. 250-lb., Stoker
1—612 HP Stirling 200-lb.
2—560 HP Erie City 460-lb.
1—484 HP Springfield 200-lb., Oil Fired
2—481 HP Springfield 225-lb., Pulverizer
2—407 HP Wickes 160-lb. Stokers
2—405 HP Erie City 160-lb., Stokers
2—312 HP Stirling 160-lb., Stokers
2—300 HP Heine 200-lb.
2—300 HP B. & W. 160-lb.

SYNCHRONOUS MOTORS

2—1250 HP G.E. 25 cy. 2200 V. 750 RPM
2—1125 HP G.E. 60 cy. 480 V. 720 RPM
1— 200 HP Ideal 60 cy. 4000 V. 514 RPM
1— 175 HP West. 60 cy. 4000 V. 514 RPM
1— 150 HP West. 60 cy. 2200 V. 600 RPM
1— 125 HP G.E. 60 cy. 220 V. 720 RPM
1— 100 HP G.E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

4—3500 HP G.E. slip ring 2300 V. 120 RPM
1—2500 HP G.E. slip ring 6600 V. 253 RPM
1—1500 HP G.E. slip ring 6600 V. 253 RPM
1—1000 HP West. slip ring 2200 V. 360 RPM
1— 500 HP G.E. slip ring 440 V. 450 RPM
2— 400 HP G.E. slip ring 3800 V. 1800 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
2— 250 HP West. slip ring 2300 V. 450 RPM
1— 150 HP G.E. slip ring 440 V. 450 RPM
1— 100 HP G.E. sq. cage 2200 V. 900 RPM
1— 75 HP G.E. sq. cage 440 V. 514 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW Allis Chalmers 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 200 KW Westinghouse 250 V. DC
1— 150 KW Westinghouse 250 V. DC
1— 75 KW General Electric 125 V. DC

ROTARIES—60 Cy.

2—2600 KW General Electric 250 V.
2—1700 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
2— 500 KW Westinghouse 600 V.

FREQUENCY CHANGERS

2—12500 KW G.E. 60/25 cy. 300 RPM
2— 5000 KVA West. 25/60 cy. 300 RPM
2— 3125 KVA West. 25/62½ cy. 750 RPM
1— 1875 KVA G.E. 25/60 cy. 300 RPM
2— 1250 KVA G.E. 25/62½ cy. 750 RPM
1— 1250 KVA G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 60/25 cy. 300 RPM

TRANSFORMERS—1 Ph. 60 Cy.

2—10000 KVA West. 115,000-6900 V. 3 ph.
4— 500 KVA West. 110,000-2300 V.
3— 4000 KVA West. 63.5/110-19/33 KV
4— 2500 KVA G.E. 63.5/110-19/33 KV.
3— 2500 KVA Pitts. 66000-25400/12700 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 750 KVA Pitts. 66000-33000 V.
3— 600 KVA West. 66000-2300 V.
3— 333 KVA G.E. 66000-480 V.
3— 100 KVA G.E. 66000-6900/11000 V.
3— 1667 KVA G.E. 44000-2300/4000 Y V.
4— 1667 KVA Pitts. 33000-2400 V.
3— 833 KVA Al. Ch. 34460-4800/2400 V.
3— 200 KVA G.E. 33000-2300/4000 Y V.
3— 150 KVA G.E. 22000-2300 V.
3— 75 KVA G.E. 33000-13200/11000 V.
14— 75 KVA G.E. 33000-2400 V. New
40— 50 KVA G.E. 33000-2400 V. New
50— 25 KVA G.E. 33000-2400 V. New
1—15000 KVA Al. Ch. 27880-4560 V. 3 ph.
2—10000 KVA West. 26400-4560 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
3— 667 KVA Packard 23000-440 V.
4— 400 KVA Pitts. 22000/11000-2200 V.
3— 200 KVA G.E. 22000/230/460 V.
1—10000 KVA West. 13200-4560 V. 3 ph.
1— 3000 KVA Kuhlman 13800-480 V. 3 ph.
3— 1667 KVA Pitts. 13200-2300 V.
4— 1250 KVA Pitts. 13500-230/460 V.
3— 200 KVA G.E. 13200-480 V. Pyranol
7— 667 KVA Moloney 11000-2300 V.
3— 100 KVA G.E. 6900-230/460 V.
3— 75 KVA G.E. 6900-230/460 V.
6— 25 KVA West. 6900-230/460 V.
3— 833 KVA Penn. 4800-240/120 V.
3— 150 KVA G.E. 2400-120/240 V.

OIL CIRCUIT BREAKERS

6— 400 A. 37 KV G.E. FHK0136 Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
1— 400 A. 25 KV G.E. FK0136 Outdoor
2— 600 A. 15 KV G.E. FK037 Outdoor
1— 600 A. 15 KV West. O-221 Outdoor
2— 400 A. 15 KV G.E. FHK0136 Outdoor
2—1200 A. 7.5 KV G.E. FK132B Indoor
6—1200 A. 4.5 KV Condit D-12 Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, New York

TURBO GENERATORS

1—937KVA Gen. Elec. with Wheeler condenser
1—500KW Allis Chalmers Moore non-cond.
1—500KW Gen. Elec. non-cond.
1—300KW Gen. Elec. cond.

ROTARY CONVERTERS

1—1500KW 250V Westgh complete
2—1000KW 250V Westgh complete

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries.

What have you for sale?

KEYSTONE

Power Plant Equipment Company

8403 Hegerman St., Phila. 36, Penna.

POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

1—6000 KW. G.E. 2300/4000 V.
1—4000 KW. 2300 V. Cond.
1—2000 KW. 600 V. Cond.
1—1500 KW. 2300 V. Cond.
1—750 KW. 2300 V. Cond.
1—750 KW. 600 V. Cond.
1—500 KW. 440 V. Non C.
1—500 KW. 125 V. D.C.
1—375 KW. 440 V. Cond.
1—200 KW. 2300 V. Cond.
1—120 KW. 440 V. Non. C.

ENGINE GENERATORS

1—168 KW. 550 V.
1—100 KW. 250 V. D.C.
1—600 KW. 2300 V.
1— 75 KW. Uniflow 240 V.

TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#
1—100 H.P. G.E. with gears

BOILERS

1—500 H.P. 200# Oil
2—175 H.P. 200# Oil
2—480 H.P. 225#
1—305 H.P. 185# Stoker
1—200 H.P. 450# Oil
1—150 H.P. 150# H.R.T.

CONDENSERS

1—6000 Sq. Ft. Surface
2—2212 Sq. Ft. Surface
1—1485 Sq. Ft. Surface

AIR COMPRESSORS

1—6700 C.F. 22# Turbine Driven
1—1600 C.F. 50# Steam Driven
1—860 C.F. 50# Diesel
1—1247 C.F. 55# Motor
1—1214 C.F. 100# Motor Driven
1—600 C.F. 350# Steam Driven
1—386 C.F. 100# Steam Driven

PUMPS

1—3000 GPM 65' Hd Motor
1—1000 GPM Fire Pump Steam
1—750 GPM Fire Pump Steam

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Mchy. Bldg., Boston, Mass.

The Buyer Must Be Satisfied—Always

SLIP RING MOTORS

3-HP., 60-CY.

HP	Volts	Make	Speed
900	2200	G.E.	900
500	440	G.E. (Hoist)	450
300	440	Al. Chal.	900
300	2200	G.E.	1800
300	400/220	Al. Ch.	900
250	2300	G.E.	600
250	440/550	G.E.	600
250	440	Whse.	450
250	550	Al. Chal.	900
200	2200/440	G.E.	1200
200	2200/440	G.E.	600
150	440	G.E.	1800
150	4000/2300	G.E.	1800
150	2200/440	G.E.	600
125	440/220	G.E.	1200
125	440/220	G.E. (Hoist)	900
125	2200	G.E. (New)	1800
100	440/220	G.E.	1800
100	220/440	G.E.	720
100	220/440	G.E.	900
100	440/220	G.E. MTC	900
100	550	G.E.	900
75	440/220	Whse.	720
75	550	G.E.	900
60	2200	G.E.	900
40	2200	Whse.	900
40	2200	G.E.	1200

SYNCHRONOUS MOTORS

3-HP., 60-CY.

300	440/220	Al. Ch.	600
200	2200	Whse.	900
110	440	Whse.	900
100	2200/550	Al. Ch.	1800
100	440/220	G.E.	360
75	440/220	G.E.	720

UNAFLOW ENGINE-GENERATOR SET consisting of:

Gen: 250 KW 200 RPM 250 volt direct connected to:

Eng: 23" x 24" Ames Unaflow 125/150# ga. non-condensing. Very modern—practically new.

1—11" x 12" Ames non-condensing Steam Engine, direct connected to a 60 KW Crocker-Wheeler 250 volt DC Generator.

TRANSFORMERS

60 CYCLE

3—500 kva., G.E., type H, form KS, 13800-230/460.
3—250 kva., Whse., 13,800-460.
3—250 kva., G.E., H-KDD, 13200-2300/575 V.
3—200 kva., G.E., type H, 34500-2300 V.
3—150 kva., G.E., type H-KDD 13200-2300.
3—150 kva., Al. Ch., type OISC 10400-2400.
3—150 kva., G.E., H-KS, 2400-240/120 V.
2—150 kva., G.E., HTQ, 4150-240/480 V.
3—100 kva., Whse., SK, 4200-460/230 V.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., G.E., type H-KR 6600/11430Y-2300 V.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230-115.
6— 50 kva., Whse., type SK, 13800-240/120.
3— 50 kva., Whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
550	440/220	G.E.	IK	900
400	2200/.40	Whse.	CS	720
250	2200	Whse.	CS	1200
250	440/220	G.E.	IK	1800
200	220/440	G.E.	IK	720
200	440/220	G.E.	IK	900
200	440/220	G.E.	IK	1200
150	440/220	G.E.	KT	720
150	440/220	G.E.	IK	900
150	2200	Allis Ch.	AN	450
150	440/220	Whse.	CS	514
125	440/220	G.E.	KT	1800
125	440/220	G.E.	K	514
125	440/220	G.E.	KT (Vert.)	1800
100	2200/440	G.E.	IK	1200
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/400	G.E.	K	1800

MOTOR GENERATOR SETS

1—75 KW, 250 V, 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V, 850 RPM, Whse. conn. to 75 HP, 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.
1—50 KW., 125 V., 1200 RPM. Whse. conn. to 75 H.P., 2200/220 V., 3 ph., 60 cy., Sq. Cage Motor.

A.C. GENERATORS

1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—187 kva., 900 r.p.m., 550 V. Whse.
1—110 kva., 900 r.p.m., 440 V., G.E.
1— 96 kva., 360 r.p.m., 480/240 V., G.E.
1—62½ kva., 1200 r.p.m., 2200 V., Cr. Wh.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

FOR SALE BY OWNER

EQUIPMENT POWER PLANT

1 — 500 KW General Electric condensing turbo-generator complete, exciter on shaft, water rate 15.5 per KW hour.

BOILERS

3 — 600 H.P. forged steel sectional header B&W water tube boilers, 225# working pressure.

1 — 45,000 cu. ft. per minute turbine driven compressor, 40" static pressure

A number of 600# pressure all steel valves, including non-return valves, outside spring, A.S.M.E.-pop-safety up to 600# pressure. All sizes.

A number of turbine driven boiler feed pumps, oil pumps and ball valve pumps.

We buy complete plants outright

WHAT HAVE YOU FOR SALE?

HOWE BROTHERS

324-328 Pearl St., New York, N. Y.

TEL. WORTH 2-2708-2709-2710

COMPLETE POWER PLANTS

STEAM—ELECTRIC—HYDRO—DIESEL

"Export Orders Carefully Executed"

SPECIAL OFFERINGS

1—2000 H.P. B. & W., 200# Boiler
2—1060 H.P. Heine Boilers 200#
4—1000 H.P. Heine 225# Boilers
2— 750 H.P. Edge Moor 200# Boilers
2— 750 H.P. B. & W. Sterling Boilers 200#
4— 600 H.P. B. & W. 200# Boilers
2— 600 H.P. Edge Moor 200# Stokers
4— 440 H.P. B. & W. Sectional 200# Oil fired
1— 335 H.P. B. & W. Sectional 200#
Smaller Boilers and Fire Tube Boilers also

1—15000 K.W., G.E. Co., Turbo-Generator Condensing
2—12500 K.W., G.E. Co., Turbo-Generator Condensing
1— 5000 K.W., G.E. Co., Turbo-Generator Condensing
3— 4000 K.W., G.E. Co., Turbo-Generator Condensing
2— 2500 K.W., G.E. Co., Turbo-Generator Condensing
2— 2000 K.W., G.E. Co., Turbo-Generator Condensing
1— 2000 K.W., W. E. & M. Co., Turbo-Generator Con.
3— 1000 K.W., G.E. Co., Turbo-Generator Condensing
2— 750 K.W., G.E. Co., Turbo-Generator Condensing
Several 500 KWs. & Smaller. And Non-Cond. Units

50 Ton 69'-10" Overhead Traveling Crane.

CHARLES B. REARICK **30 CHURCH ST.** **NEW YORK**

Motor Generator Sets—Synchronous Motors, Etc.

SLIP RING MOTORS

3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

SYNCHRONOUS MOTORS

3 phase,60 cycle, A. C.

1—Ideal 3-bearing 250 HP 600 RPM 440 Volt
1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

VERTICAL MOTORS

1—Reliance fan-cooled 25 HP 1750 RPM 220/440 Volt

D. C. EQUIPMENT, 230 VOLT

1—G.E., MPC 150 HP 262/750 RPM
1—Triumph 110 HP 292/600 RPM
1—Diehl 125 HP 400/1200 RPM
A large nummber of adjustable speed D.C. motors from 5 to 100 HP.

ALTERNATORS SPECIAL, Allis-Chalmers, 125 KVA 277 RPM 3 Phase, 60 Cycle

The Electric Motor & Repair Co., Cuyahoga Falls, O.

5000 KVA. Turbo Generator Plant

3/60/2200 v. 3600 RPM. 200# 100° with Surf. Condenser, Boilers, etc., operating. 375 KVA. Non-Cond. 3/60/2300 v. 150#

STEPHEN A. DOUGLASS CO.

630 Fort Washington Ave. New York, N. Y.

ELECTRICAL EQUIPMENT

FOR

INDUSTRY

LET US KNOW YOUR REQUIREMENTS

MERCURY ARC RECTIFIERS

1—1500 KW, 250 V—DC, 22000 V—AC, 3 PH.
1—1000 KW, 250 V—DC, 4000 V—AC, 3 PH.
2—1000 KW, 600 V—DC, 4000 V—AC, 3 PH.
2— 300 KW, 250 V—DC, 11500 V—AC, 3 PH.

MOTOR GENERATOR SETS

1—200 KW, 275 V—DC, 2300 V—AC, 3 PH.
1—100 KW, 275 V—DC, 2300 V—AC, 3 PH.

JOHN D. CRAWBUCK COMPANY

714 Ark Way North Side Pittsburgh 12, Pa.

VALVES

INDUSTRIAL & MARINE

METROPOLITAN PLUMBING SUPPLY CO., INC.

Power Plant Valves and Engineering Specialties for Oil, Steam, Gas, Air, Liquids and Chemicals.
Jenkins, Fairbanks, Sarco, Powell Valves and surplus.
Large Complete Stocks ⅛" to 24"
313 EAST 31st., NEW YORK CITY
For Hourly Nationwide Shipments
CALL MUrray Hill 3-3408

SKETCH PIPE & FITTINGS

SMALL STEAM GENERATING UNITS—ENGINES

SPECIAL: 1—480 KW, 743 HP Simplex-Corliss Valve Engine 30" stroke 24" bore with 1—480 KW 60/3/480V/160# 10# B.P. generator; all auxs. Excellent condition—can be seen in operation.
1—300 KVA high speed Corliss Engine 20 x 24 200 RPM. Generator: 60/3/480V/200 RPM. All auxs.
1—21 x 21 Ames Unaflow with D.C. generator 125-250 Volts.
1—200 KW Horizontal Skinner Uniflow; 2 wire, 200 RPM, complete with 125 Volt DC generator. All auxs.
1—335 KVA Harris Unaflow 26" dia. x 28" stroke, 480 IHP, 125# 180 RPM, with a 375 KVA 60/3/2300V Westinghouse generator.
1—400 KW Allis-Chalmers 18" x 36" Drop Piston Engine 175#, 150° S.H. 150 RPM; 25# B.P. with a 400 KW 60/3/480V generator.

TURBOS:

1—375 KVA Wemco Cond. 3/60/240V/900 RPM/150# with direct connected exciter. Surf. cond. all auxs.
1—300 KW G.E. 60/3/240V. Bleeder, 400.# per hr. 10# B.P. Cond. & N.C.
1—500 KW Wemco mult. exp. parallel flow 60/3/440V/3600 RPM; 150-200# 10# B.P.
1—300 KW G.E. Curtis N.C. 3600 RPM. 3/60/2300V 125#; 1# B.P.
1—500 KW G.E. N.C. 3600 RPM. Generator 60/3/2300V with dir. connected exciter, 100-125#; 2# B.P.
1—500 KW 4 stage N.C. G.E. Turbine 210#, 150° S.H.
4—10# B.P. Generator: 2/60/3600 RPM. New 1931.
1—750 KW Moore-Allis 200#, 10# B.P. Generator: 3/60/440V. Boiler complement 225# operation.
1—500 KW Allis-Chalmers 3/60/2300V/3600 RPM surf. cond. Boiler complement.
1—500 KW Allis-Chalmers 3/60/2300/3600 RPM Cond. Turbogenerator Complete Switchboard.
3—500 KW Wemco Bldrs. 60/3/240V/3600 RPM/150#/100° S.H. Bldg. 10#G.

BOILERS:

SPECIAL BOILER RELEASES:

1—1000 HP Edgemoor 215#-125° S.H. Long Drum Str. tube. Bargain—Immediate Acceptance.
1—Complete Boiler Layout 600 HP—2 Casey Hedges—2 Erie City 150#—Stoker Equipped—1928.
1—1250 HP steam generation plant complete, Superheater, Economizer, Steel Encased 14 Retort Stoker, 100,000# Cont.
1—612 HP Stirling, 200#.
1—500 HP Heine, 350#.
1—400 HP Comb. Eng. 350#.
1—444 HP Union Iron Works 200#.
2—365 HP Edgemoor 225# 100° S.H. Stoker.
1—313 HP Edgemoor 250# 125° S.H. Stoker
1—350 HP B&W Stirling 150# Stoker
1—500 HP Edgemoor 175# Stoker
1—305 HP Kidwell 185# 125° S.H. Stoker.
1—125 HP Leffle Scotch Marine 125# Oil Burners.
1—200 HP Brownell HRT 125# New 1936—Stoker.

SPECIALS:

1—5000 KW Freq. 13,200V/4150V—62½ cyc. 3-25 cyc. trans.
3—500 KW Rotaries 240/300V 375 RPM 3/25/13,200.
Also, Diesels, M.G.'s to suit specifications.

50 YEARS OF SERVICE

LET US PLACE YOUR MODERN IDLE EQUIPMENT

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
20	Westg.	220	575	CW
20	Allis Chal.	440	1130	
25	Westg.	220	720	CW
30	Westg.	220	900	CW
30	West.	220/440	787	CS
50	Westg.	440	1145	HF
50	Chandeys'n	220/440	1800	
100	West.	220/440	685	CW
150	West.	2200	375	CW
150	West.	2300	490	CW
150	West.	220/440	490	CW
200	Burke	440	600	EMV-65
300	G.E.	440	900	I
300	Westg.	2300	580	CW
400	Westg.	2200	435	CW-1214
1500	Westg.	2200	435	CW

ALTERNATING CURRENT MOTORS

3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
25	West.	220/440/550	1200	CS
25	Lincoln	440	900	
25	West.	220/440	1160	CS
30	G.E.	440	1800	KT
30	Allis Chal.	220/440	1200	
30	West.	220	450	CS
35	Allis Chal.	440	1200	
35	West.	220	495	CS
35	West.	220/440	575	CS
40	Howell	220	900	SO
40	G.E.	440	1800	KT-527-4
40	Triumph	440	1760	S8825
40	G.E.	440	900	KT
40	West.	220/440	720	CS
40	West.	220	514	CS
50	West.	220/440	900	CS
50	West.	220	600	CS
50	G.E.	220	1200	
50	Fair Morse	220	900	
50/150	West.	2200	360/720	CS-954
50	West. El.	220	570	KT-346
50	Chandeys.	220/440	1800	
50	Cr. Wh.	240/480	1200	Syn.
50	G.E.	220/440	1200	HI
50	G.E.	440	1160	KT
50/32	G.E.	440	800/640	
65	West.	220	720	CS
75	West.	220	900	CS
100	Allis Chal.	220	1750	
100	Allis Chal.	220	600	
150	Wagner	440	1800	31V
150	G.E.	2200/220/440	450/243	
175	G.E.	2200	600	I-12
200	Westg.	2200	900	
1500	G.E.	2200/220/440	225	ATI-Syn.
3500/	West.	4000/23000	900	Syn.

VARIABLE SPEED MOTORS—230 VOLT D.C.

H.P.	Make	R.P.M.	Type
1.5	Roth	850/1700	
2	Star	400/600	SB
2	G.E.	400/1600	RLC
2	G.E.	415/830	RLC
2	Reliance	550/2000	
2½	Westg.	450/900	SK-30
2½	G.E.	500/1000	RLC
2½	Reliance	500/1000	14T
3	Jantz-Liest	650/1950	BI-DC
3	Roth (Enclosed)	500/1000	RS
3	G.E.	400/1200	RLC-114
3¼	Westg.	400/1600	SA
3½	Westg.	850/1700	
5	Reliance	600/1800	
6	Roth	500/1000	
7½	Westg.	450/900	80L
7½	Reliance	650/1300	550v
7½	Westg.	1125/2905	SK-43
7½	Westg.	400/1600	SA
10	Westg.	565/1130	S-6
10	G.E.	625/1250	LC
10	West.	400/1600	SA
15	Reliance	500/1800	
20	Westg.	750/1500	SK-110L
30	G.E.	450/900	RLC
75	West.	400/650	SK-181

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
6	Ilg.	230	380	
10	West.	230	650	MT-00
15	Cr. Wh.	220	270	SM
15	West.	230	800	HD
25	West.	230	600	MT
32	Shaw	230	485	5L2E
68	G.E.	220	475	
80	West.	230	490	76-A
175	G.E.	230	475	MD

TRANSFORMERS— 1 ph. 60 cy.

No	KVA	Pri.	Sec.	Make
1	2	6600	110/220	G.E.
3	5	2300	220/440	G.E.
1	5	2200	110/220	West.
84	7½	2200	220/110	G.E.
32	7½	2200	220/110	West.
12	10	2200	220/110	West.
13	10	2200	220/110	G.E.
2	10	2300	220/110	G.E.
3	15	2200	220/440	G.E.
2	15	400/30000/50000		American
1	25	2200	220/110	G.E.
3	25	2200	220/440	G.E.
3	50	2200	220/440	G.E.
3	50	6600	575/440/220	G.E.
2	50	6600	550/440	Al. Ch.
1	75	2200	220	Burke 3 ph.
3	75	2200	220/440	West.
3	125	2200	220/440	G.E.
3	250	6600	2300	West.

HOIST

1—3 ton Westghse Hoist with Westghse DC Mtr., 1600 rpm.

D.C. CLARK CONTROLLER

1—250 HP Clark Vari time magnetic controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

MOTOR GENERATOR SETS

250 volts

1—5 kw. Allis Chalmers 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—7½ kw. West. 1150 rpm. Gen. dir. conn. to 220/440 220/440 v. 3 ph. 60 cy. Induction Motor.
1—10 kw. West. SK 1150 rpm. Gen. dir. conn. to 220/ v. 3 ph. 60 cy. Induction Motor.
1—15 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—20 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—25 kw. Triumph 1750 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—25 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—150 kw. West. 250 v. 900 rpm. Gen. dir. conn. to 290 HP 440 v. 3 ph. 60 cy. West. Syn. Motor.
3—250 kw. Cr. Wh. 250 v. 500 rpm. DC Gens. with 3—250 kva. Cr. Wh. Syn. 220 v. 3 ph. 25 cy. Motors.

125 volts

1—5 kw. 125 v. 1150 rpm. Allis Chal. Gen. dir. conn. to 3 ph. 60 cy. 220/440 v. AC Induction Motor.

WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

DUQUESNE ELECTRIC & MFG. CO. **Pittsburgh 6, Pa.**

TURBO-GENERATOR *Immediate Delivery*

Units Noted Below Are Now In Our Stock—All Are 3 Phase, 60-Cycle, 3600-RPM

7500—KVA. G.E. Sur. Cond., 190/375#: 2300-v.
6250—KVA. G.E. Sur. Cond., 200#, 2300-v.
3125—KVA. G.E. Sur. Cond., 200#, 2300-v.
3750—KVA. G.E. Sur. Cond., 200#, 2300-v.
2500—KVA. G.E. Sur. Cond., 200#, 2300-v.
1875—KVA. G.E., COND. 200#.
1565—KVA. G.E. Sur. Cond. 150#, 2300.
1000—KW. West. D.C.
1250—KVA. West. Sur. Cond. 200#, 2300.
937—KVA. Allis-C. Cond. 200#.
625—KVA. G.E. Cond. 200#, 2300-v.
375—KVA. G. E. 250-KVA. Non-Cond.

ALSO ALMOST ANY TYPE OR CAPACITY TURBO-GENERATOR DESIRED

Send us Your Specifications—Correspondence Invited

WILMS, WEAVER & CO.—Steam Turbine-Generator Specialists

4045 Penobscot Building — Detroit (26) Michigan

4000 K.V.A. COND. OR NON COND. TURBO.

WITH COND.—4100 V.—2300 V., 60 Cy., 3 Ph.
2—4166 GPM. 162' HD. CENT. PUMPS (PRAC. NEW), 12" SUC.—12" DISC.
36000-25000 GPM. 27'-40' HD. CENT. PUMP 42" SUC. 36" DISCHARGE
20" AND 24" VALVES—ELLS—TEES—(PRAC. NEW)
1500 CFM 2 STAGE AIRCOMP. 275 HP. 60 CY. 2200 V. SYN. MOTOR
WATER WHEELS—WESTERN SHIP
1625 HP. 240 RPM. 1600 HP. 550' HD. 1500 HP. 150' HD.
725 HP. 160' HD. 310 HP. 450 RPM, WITH AC GENERATOR
425 KVA. 2200 V. GEN. DIR. 60' HD. 500 HP. 35 HEAD 300 RPM.
WOOWARD GOV. SIZED-VERTICAL AND PULLS.

ROSS POWER EQUIPMENT CO., Indianapolis, Ind.

TURBO GENERATOR UNITS

Good Values

1 — G. E. 100 KW, 3 ph, 2300 volt, 3600 RPM Non Condensing, 125 PSI
1 — G. E. 200 KW, 3 ph, 2300 volt, 3600 RPM, non-condensing, 150 PSI
1 — Allis Chalmers 650 KW, 3 ph, 2300 volt, 3600 RPM condensing, 200 PSI
1 — Westinghouse, 1000 KW, 3 ph, 2300 volt, 3600 RPM, condensing
1 — Complete Steam Generator Plant, 2600 KW, total capacity. G. E. 440 volt, 3 ph, 60 cycles. 2 units 1000 KW and 1 unit 600 KW Condensers, switchboard and 4 HRT 72x18 Boilers
1 — Steam Generator Plant, 3300 KW, total capacity.
Allis Chalmers 2000 KW } condensing
Allis Chalmers 800 KW }
G.E. 500 KW mixed pressure

SUNDFELT EQUIPMENT COMPANY
3422 1st Ave. S. Tel. Main 1474
Seattle 4, Washington

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We have several thousand transformers in stock for prompt shipment, and invite your inquiries

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes.

One Year Guarantee

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI 27, OHIO

STEAM GENERATOR SETS

1—50 KW Engberg Vertical 125 volt DC, 416 Amps. 300 RPM, 100 lbs. pressure, Flywheel governor.
3—35 KW Sturtevant Vertical 125 volt DC, type VS7, 10x9, 100 lbs. pressure Flywheel governor.
2—35 KW Westinghouse Turbines 125 volt DC, 100 lbs. pressure.
Immediate Delivery Excellent Condition
ALJON ELECTRIC DIESEL CO.
151-55 Washington St., Brooklyn 1, N. Y.
Main 4-3894

SYNCH. CONVERTERS

500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
150 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

500 KW G.E. SYN. 250 V. 2300/4000 A.C. 900 RPM
300 KW WEST. SYN. 250 V. 2200/4000 A.C. 900 RPM
200 KW G.E. IND. 600 V. 2300/4000 A.C. 1200 RPM

Each unit listed above is owned by us and is available now for immediate purchase

WALLACE E. KIRK CO.
Incorporated
502 Grant Building, Pittsburgh, Pa.

PUMPS

Rebuilt & Guaranteed

PUMPS—Large stock centrifugal—turbine—piston

STEAM PUMPS—Duplex - Simplex Reconditioned and guaranteed

BOILERS—stacks—Engine Generators—condensers.

LOU COHEN & CO.
1030 N. 6th St. St. Louis 1, Mo.

BOILERS

NEW and USED

All makes & sizes for prompt shipment

Special Offer
400-HP....175 lbs.
Stirling Boilers

J. F. DAVIS CO.
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Telephone Harrison 0755

TRANSFORMERS

New or used. All types and sizes. Air and oil cooled. Phase changers a specialty.

ATLANTIC TRANSFORMER CO.
Transformer Specialists
5143 N. 2nd St. Phila., Pa.

IMMEDIATE DELIVERY

ELECTRIC MOTORS

Direct Current—230 Volts

1—10 HP Crocker-Wheeler—Type CM—825 r.p.m.
1—10 HP Crocker Wheeler—Type CCM—825 r.p.m.
1—10 HP Crocker Wheeler—Type CM—870 r.p.m.
1—15 HP Crocker Wheeler—Type CM—800 r.p.m.

Direct Current—115 Volts

1—25 HP Westinghouse—Type S—630 r.p.m.
1—17.5 HP Crocker Wheeler—Type CM—340 r.p.m.
1—10 HP Crocker Wheeler—Type CCM—1750 r.p.m.
1—10 HP Crocker Wheeler—Type CM—580 r.p.m.
1—20 HP Crocker Wheeler—Comp.—1200 r.p.m.
1—7.5 HP B.F. Sturtevant—Type MP4—550 r.p.m.
1—7.5 HP Crocker Wheeler—Type CM—875 r.p.m.
1—3.75 HP Crocker Wheeler—CM—440 r.p.m.
1—6 HP Crocker Wheeler—Type EM—960 r.p.m.
1—5 HP Sprague Elec. Co.—Slip Ring—520 r.p.m.
1—5 HP Crocker-Wheeler—Type CM—950 r.p.m.
1—5 HP Sprague Electric Co.—Lundell Motor Cont. —1050 r.p.m.
1—4 HP Sprague Electric Co.—Lundell Motor Cont. —815 r.p.m.
1—4 HP Crocker-Wheeler—CCM—1375 r.p.m.
1—2 HP Holtzer & Cabot Elec. Co.—Type C—250 r.p.m.
1—2 HP Sprague Elec. Co.—Lundell Motor Cont.—800 r.p.m.
1—¾ HP Crocker-Wheeler—Type SM—600 r.p.m.
1—1/3 HP Sprague Elec. Co.—Type RT—725 r.p.m.
1—3 HP Western Elec.—Type CVC Shunt—1100 r.p.m.
1—1 HP Crocker-Wheeler—Type CM—1200 r.p.m.
1—2 HP Crocker-Wheeler
1—½ HP Crocker-Wheeler—Type CM—550 r.p.m.
1—2 HP Sprague Elec. Co.—Lundell Motor—1150 r.p.m.
1—1.7 HP Crocker-Wheeler—Type CM—1100 r.p.m.
1—2 HP Crocker-Wheeler—Type CM—1487 r.p.m.
1—7.5 HP Crocker-Wheeler—Type CM—385 r.p.m.

MISCELLANEOUS

Induction Type—220 V.—2 Ph.—60 Cy.

1—5 H.P. Burke—Type EB 5—1130 R.P.M.
1—5 H.P. Burke Type—EB 75—900 R.P.M.
1—7½ H.P. Robbins & Myers—Type K—850 R.P.M.
1—10 H.P. Burke—Type EM 1.2—900 R.P.M.
2—20 H.P. Burke—Type EM 3—1200 R.P.M.
1—20 H.P. Crocker Wheeler—1170 R.P.M.
1—35 H.P. Burke—Type EM—4.5—900 R.P.M.
1—50 H.P. Burke—Type EM—4.5—1200 R.P.M.
1—150 H.P. West—Type CW—1765 R.P.M.

GENERATORS

One 250 K.V.A. and one 300 K.V.A. Crocker Wheeler Generators direct connected to Skinner Tandem compound engines—480 volts—3 phase 60 cycle, switchboard, instruments, piping.

One 300 K.W. General Electric Generator, 2300 v., 3 ph., 60 cy., direct connected to Curtis Steam Turbine, 175 lbs. pres.—3600 R.P.M. with 15 K.W. G.E. direct connected exciter.

EMSCO EQUIPMENT CO.
EMIL A. SCHROTH, Owner
50 Hyatt Ave. Newark 5, N. J.
Phone Mitchell 2-3536

NEW INSULATED MAGNET WIRE

Size	Description	Approx. Weight
.072" (#13 Awg)	Triple Cotton Cov., Round	306#
.072" (#13 Awg)	Asbestos In., Reels	134#
.081" (#12 Awg)	Single Glass Cov., Round	2,000#
.081" (#12 Awg)	Single Glass Cov., Round	685#
.128"	Asbestos Ins., Varnish, Round	495#
.049"x.437"	Double Cotton Cov., Rect.	647#
.051"x.114"	Double Glass Cov., Rect.	2,000#
.051"x.325"	Double Cotton Cov., Rect.	514#
.057"x.162"	Asbestos Ins., Rect.	851#
.057"x.365"	Double Glass Cov., Rect.	525#
.064"x.312"	Double Cotton Cov., Rect.	500#
.064"x.325"	Asbestos Ins., Rect.	130#
.064"x.365"	Double Cotton Cov., Rect.	1,050#
.085"x.195"	Double Cotton Cov., Rect.	340#
.100"x.315"	Double Cotton Cov., Rect.	1,000#
.102"x.289"	Asbestos Cov., Rect.	692#
.102"x.325"	Double Glass Cov., Rect.	10,000#
.106"x.256"	Double Glass Cov., Rect.	180#
.114"x.258"	Double Glass Cov., Rect.	421#
.144"x.229"	Double Cotton Cov., Rect.	1,000#
.162"x.162"	Asbestos Ins., Rect.	474#
.182"x.289"	Double Cotton Cov., Rect.	672#
.100"x.500"	Double Glass Rect.	1,050#
.100"x.400"	Double Glass Rect.	1,074#
.035"x.135"	Double Vitreous	1,681#
.070"x.250"	Double Vitreous	4,726#
.110"x.185"	Double Vitreous	3,160#
21 Awg	Single Vitreous	2,800#
17 Awg	Double Cotton Cov.	7,000#

Immediate Delivery

DULIEN STEEL PRODUCTS INC.
2280 Woolworth Bldg. N. Y. 7, N. Y.
Tel. Cortlandt 7-4676

1—440 HP Elec. Machinery, 3-60-440V, 900 RPM, two bearing syn. motor
1—400 HP Westinghouse, type CW, 3 ph. 60 cy. 440V, 450 RPM slip ring motor
1—300 HP General Electric, 3 phase, 60 cycle, 440 volt, 360 RPM, type Mt 412 slip ring motor
1—275 HP Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1175 RPM slip ring motor
1—200 HP Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1150 RPM slip ring motor
1—200 HP Westinghouse, 3-60-2200V, 600 RPM syn. #4956114, direct conn. exciter & starter
2—100 HP General Electric, type I, form K, 3-60-220V 575 RPM
1—100 HP Westingrouse, type CCL, 3 ph, 60 cy. 2200 V, 1750 RPM, Squirrel Cage
1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy. 220V, 580 RPM slip ring
1—100 HP General Electric 3 ph, 60 cy, 4000V, 720 RPM syn., type TS with direct connected exciter
1—100 HP Westinghouse, type CS, 3 ph, 60 cy, 440V, 1750 RPM sq. cage
4—75 HP G. E. 3-60-2300V, 400 RPM, type I, sq. cage
1—75 HP General Electric, 3 phase, 60 cycle, 440 volt, 450 RPM, type I, form M, slip ring motor
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring
1—75 HP Fairbanks-Morse, type H, frame 105C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage
1—75 HP Lincoln, type IQ, 3 ph, 60 cy, 3 phase, 440V, 600 RPM Squirrel Cage
2—75 HP Fairbanks-Morse, 3 phase, 60 cycle, 2200 volt, 1800 RPM, slip ring motors
1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage, 900 RPM
1—50 KW factory built m-g set, 125 Volt, Ideal 900 RPM, driven by 75 HP. sq. cage 220/440 V. motor
1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K
1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring
1—60 HP General Electric, 3 phase, 60 cycle, 440 volt, 600 RPM, type MT 556 slip ring motor
1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring
1—50 HP Triumph 3-60-440V, type C12 1150 RPM, slip ring, rotor & stator rewound
1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring
1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage
2—50 HP Allis-Chalmers, 3-60-440V, 890 RPM slip ring
1—50 HP General Electric, 3-60-440V, 690 RPM, MT 546, slip ring
1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage
1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage
1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage
1—50 HP Allis-Chalmers, 3 ph, 60 cy, 550V, 860 RPM Sq. Cage
1—50 HP General Electric, type I-M, 3 ph, 60 cy, 440V, 720 RPM slip ring
1—45 KVA Fairbanks-Morse, 3 ph, 60 cy, 220V, 1200 RPM alternator
2—30 HP Fairbanks-Morse, 3 ph, 60 cy, 2220V, 3600 RPM, type HO, frame 12B ball bearing
1—50 KW, Allis-Chalmers, factory-built, 3 bearing M-G set, 125 volt DC, driven by 75 HP, 3 phase, 60 cycle, 220 volt, 1165 RPM motor
2—175 HP, 230V, DC Westinghouse, type SK, 550 RPM
1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM
1—60 HP Westinghouse, type SKI40L, 115V, 1150 RPM vertical
1—50 HP Westinghouse SK200, 230V, 250/900 RPM

THE WENTE ELECTRIC CO.
Hamilton, Ohio
Rebuilt Motors & Generators Since 1906

ELECTRIC EQUIPMENT CO.
63 CURLEW ST.
ROCHESTER 1, N. Y.
P. O. Box 51 Phone: Glenwood 6783-4-5

• SPECIALS •

1000 KW. 250 v. steam engine generator set

500 KW. DC M.G. 600 v. DC 900 speed, Allis Chalmers. For any AC voltage drive

400 KW. 3 unit 250/500 volt Gen. Elec. Syn. M. G. set, 2300/4000 volt AC drive

120 KW. 250/500 v. DC gasoline engine gen. set

100 KW. 125 volt, G.E., 1200 rpm. M.G. set any AC volt

70 KW. M.G. Set 70 v. 1000 Amp. Burke, syn. drive

35 KW. 125 v. M. G. set. For any AC voltage drive

50—New 3 HP. G.E. 1800 rpm. 220 volt slip ring motors

100 KW. 125/250 volt, 1200 rpm. General Electric synchronous rotary converter

300 KW. 250 v. West. 900 rpm. syn. rotary converter

4—200 HP. G.E. type KF vertical 440-60-3-900 Class 1-D explosion proof motors

1—100 HP. same description as above

129—15 KW. Westinghouse type SK 83, 125 volt, 1200 rpm. New D. C. Generators

3—200 HP. G. E. type KT 440-60-3-900 bare motors

2—100 HP. G. E. type KT 440-60-3-600 BB motors

15—New Reliance type 2VS vertical MG sets

18—New Reliance type 5 VS vertical MG sets

ELECTRIC EQUIPMENT CO.
BOX 51, ROCHESTER, N. Y.
PHONE GLENWOOD 6783

PUMPS MOTOR & STEAM DRIVEN

G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3500	140′	Kingsford	Centrif.
2400	55′	American	Centrif.
1100	220′	Allis-Chalm.	Centrif.
1500	160′	De Laval	Centrif.
400	625′	LeCourtenay	Centrif.
250	525′	LeCourtenay	Centrif.
400	350′	Goulds	Triplex
300	500′	Goulds	Triplex
175	500′	Goulds	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
300	150′	Viking	Rotary
1000	460′	Knowles	Steam
750	460′	Snow	Steam
500	100′	Foster	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

M. G. & STEAM DR. SETS

K.W.	Make	Volts	Type
25	Green Eng.	220 D. C.	Beld Drive
100	Ames	240 D. C.	dir. dr. Eng.
75	Ames	240 D. C.	dir. dr. Eng.
17	Sturt. Turbine	110 D. C.	Direct Drive
7½	Sturt. Turbine	110 D. C.	Direct Drive

D.C. MOTORS ALL SIZES

100 Northwest	220	1750
25 Roth	230	1750
10 Crock. Wheel	110	925
10 Weschge	110	1700

1½ to 7½ H. P. ALL MAKES

CONDENSATION RETURN UNITS

Nash-Jenn Dump. Vac. Heat, 26000EDR
Nash-Jenn Simp. Vac. Heat, 1600EDR
Condensation Units, 100 to 250,000EDR

AIR COMPRESSORS

G.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
140	125	Curtis	Vert. Dup.
100	125	Ing. Rand	Vert. Dup.
28	5000	Norwalk	4-Stage

TURBO-CENTRIFUGAL BLOWERS

1800	5¼ lbs.	In. Rand	Motor dr.
900	10½ lbs.	In. Rand	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24–45 oz.	Spencer	Motor dr.
450	24 oz.	Spencer	Motor dr.
250	16 oz.	Spencer	Motor ur.

BLOWERS & EXHAUSTERS

C.F.M.	St. Pres.	Make	Type
100–60000	½"–5"	Buffalo	Various
100–15000	½"–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press	Make	Type
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
500	3 lbs.	Roots	Belt dr.
200	5 lbs.	Baker	Direct dr.
110	15 lbs.	Beach R	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth	Belt dr.
100	high vac	Beach R	Gear dr.
100	27 in.	Deane	Belt dr.
100	29 in.	Devine	Belt dr.
100	20 in.	Nash	Direct dr.

MOTORS (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
150	West.	440	700	CS
125	G.E.	220	1150	Vertical
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	Sl. rg.

Also 10 to 30 H.P. in All Makes

SIMILAR EQUIPMENT IN STANDARD MAKES AND SMALLER SIZES
HIGHEST PRICES PAID FOR YOUR IDLE EQUIPMENT

SUPERIOR EQUIPMENT CO.

138 Grand St., N. Y. C. Tel. CAnal 6-6983-4

STEAM ENGINES
Turb. Cent. Bronze Pumps
Steam Pumps—All Sizes
10"x10" Greenfield Vertical
7"x7" Wickes Bros. Vertical
6"x6" Vertical & Smaller
1 to 40 H.P. Steam Turbines

POWER EQUIPMENT COMPANY

OIL—AIR CIRCUIT BREAKERS

4—500 A. GE FK 12 3 PST 15,000 V. Handle, Trip Coils and Currents.
1—800 A. Conduit E4 600 V. 3 PST. Handle. Trip Coils and Currents.
1—1200 A. GE FK 132 A 3 PST 7500. Handle with Trip Coils and Current Transformer.
1—3000 A GE CK 8 Air Breaker 3 PST 600 V. O.L. & U.V.
1—3000 A GE FK 25 Oil Breaker 3 PST 600 V. Solenoid operated with currents.

Sq. Cage—220/440 V. 60 Cy. 3 ph.

Qu.	HP	Make	Type	Speed
2	50	G.E.	KT 327	1800
2	100	G.E.	IK	1800
1	150	West.	CS	1800

Slip Ring—220/440 V. 60 cy. 3 ph.

1	40	West	CW	720
1	50	G.E.	I-M	900
1	60	G.E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

D. C. Variable Speed 230 V.

1	15	West.	SK	400/1600
1	25	West.	SK	400/1200
1	50	West.	SK	500/1500
1	50	G.E.	CD	400/1600

SEVERAL HUNDRED OTHER ITEMS IN STOCK
ABOVE ONLY SPECIALS—ALL REBUILT—STOCK SHIPMENT

154 ANDREWS ST. Tel. MAin 568 or 569 ROCHESTER 4, N. Y.

DIESEL POWER EQUIPMENT

1—1500 HP Nelseco, solid injection with AC Generator
1375 HP (2 units) McIntosh-Seymour with General Electric AC Generators, complete plant.
1—750 HP National Superior (can be supplied with AC Generator)
1—750 HP Busch-Sulzer diesel engine generator unit
4—400 HP DeLaVergnes with AC Generators
2—400 HP DeLaVergnes with DC Generators
2—200 HP Atlas power units
1—150 HP Buckeye with or without Generator
1—120 HP Fairbanks-Morse with AC Generator
2—60 HP Fairbanks-Morse power units
1—55 HP Ingersoll Rand with belt flywheels
1—50 HP International Harvester power unit

• • •

Advise Your Diesel Power Requirements

A. G. SCHOONMAKER CO.
50 CHURCH ST. PHONE WORTH 2-0455
NEW YORK 7, N. Y.
Business Established 1898

NEW DIESEL-GENERATORS

WE OWN AND CAN SHIP IMMEDIATELY

2—New Caterpillar D13000 diesel engines with electric starting equipment, direct connected to new 75 KW generators each with new 20 KW top mounted, belted generator, complete with instruments, batteries, spare parts, etc. No priority or release required.

L. B. SMITH, INC.

CAMP HILL, PA. HARRISBURG 7331

DIESELS

H.P.	Engines	Kva	Gen.	Year
1000	McIntosh Sey.	1000	G. E.	1931
750	Superior	600	G. E.	1933
625	Worthington	622	West.	1933
500	Busch Sulzer	437	G. E.	1920
375	McIntosh Sey.	372	G. E.	1931
375	Worthington (2)	425	West.	1933
360	Fairbanks Morse 32	300	F. M.	1932
330	G. M. (Winton)	282	G. E.	1937
330	G. M. (Winton)	282	West.	1937
262	Buckeye	219	Ideal	1938
240	Buckeye	187	Ideal	1932
150	Buckeye	100	G. E.	1937
125	Buda (909) (2)	93	Burke	1938
100	International	50	G. E.	1945
50	International	25	E. M.	1945

ROBERT SCHOONMAKER
Diesel Sales Engineers
Port Washington, Long Island, N.Y.
Phone Roslyn 1220

TWO ERIE CITY W. T. BOILERS

Single settings, longitudinal drum, straight tube, each consists of (1) 60" steam and water drum, 203-4" x 18' tubes, soot blowers, feed water regulator, stop valves and Combustion Engineering Co., Type E. under feed, side dump, forced draft stokers. A.S.M.E. & Penn'a. St'd. stamping. Being prepared for immediate shipment.

H. P. BREARLEY
3423-91st St., Jackson Heights, N. Y.

WATER TANK & TOWER

60,000 gal. capacity tank on 89'9" tower with 10" riser pipe

IRON & STEEL PRODUCTS, INC.
13488 S. Brainard Ave., Chicago 33, Ill.
"ANYTHING containing IRON or STEEL"

PIPE

CUT TO SKETCH ⅛"–24"

METROPOLITAN PLUMBING SUPPLY CO., INC.
INDUSTRIAL AND MARINE SUPPLIES
LARGE SURPLUS STOCK
STEEL-WROUGHT IRON-CAST IRON
BRASS-COPPER-CEMENT LINED PIPE
Power Plant Valves & Engineering Specialties - Jenkins - Fairbanks & Sarco Valves
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HOURLY NATION-WIDE SHIPMENTS
Phone MUrray Hill 3-3408
FLANGED VALVES & FITTINGS

UNIT HEATERS

Two large unit heaters, floor type, manufactured by Skinner Company, St. Louis, Mo. 7000′ steam radiation each, size 5′x5′x7′ high, complete with 2 HP motors and steam traps.

National Boiler & Equipment Co.
1378 Madison Ave., Indianapolis, 5, Indiana

BOILERS

Complete Power Plant consisting of:

2— 500 HP Heine Boilers, 210# pressure.

4— 768 HP Sterling Boilers, 210# pressure.

2—1040 HP Heine Boilers, 210# pressure.

The above boilers complete with super heater, soot blowers, including pulverized fuel equipment, heaters and auxiliaries, and 2—12,500 KW General Electric, 3-60-6600 Turbines with surface condensers, all auxiliaries, designed for extraction. The above plant is ready for immediate shipment and is in excellent condition.

ENGINE GENERATOR SETS

1—150 KW Skinner Uniflow Engine Generator Set A.C.
1—1060—KVA Nordberg Uniflow Engine Generator.

TURBINES

2—5000 KW Westinghouse 3600 RPM 3-60-2300 volts Condenser, all auxiliaries.
1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
15,000 KVA Westinghouse turbine, condenser.
1—250 KVA Waite Turbine either condensing or non-condensing.

DIESEL ENGINES

1—200 K.W. Fairbanks-Morse Full Diesel Engine Generator.
1—200 KW Fairbanks-Morse Full Diesel.
1—350 KW Busch Sulzer 3-60-2300 Volt, all auxiliaries.
1—Busch Sulzer Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
1250 KVA Nelesco engine generator.

ENGINE GENERATOR SETS

1—500 KW Non Releasing Corliss, 3-60-240 volts.
2—400 KW Skinner Uniflow, 3-60-440 volts.
1—625 KVA Bates Corliss engine.
1—10' diameter by 140' high Self Supporting Stack.

MISCELLANEOUS

90,000 pound Cochrane Hot Process Lime & Soda Softener.
2500 HP Cochrane Open Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
2—6 Retort Taylor Stokers. First-Class condition.
2—300 HP Westinghouse Underfeed Stokers, rebuilt.
1—800 HP Hoppes open feedwater heater.
2—75 HP Elliott Geared 900 rpm turbines 385# steam pressure.
1—232 GPM Centrifugal Boiler Feed Pump, turbine driven, 1200 ft. head.

SEE Fletcher FIRST!

FLETCHER SALES CO.

325 Fincastle Building — LOUISVILLE, KY.

FOR SALE

2—Motor Generators, 3 phase to 110 volt, D.C. output, 75 and 90 KW—Perfect condition.

also

1—100 KW 900 RPM Alternator, various diesel and steam generating units, industrial and marine. Complete installation and engineering service.

1—Steam reciprocating 50 KW. 110 volt D. C. Marine Set.

Arnessen Electric Co.

116 Broad St. New York 4, N.Y.

Bowling Green 9-8542

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY

Jackson, Miss.

POWER EQUIPMENT

SLIP RING MOTORS

Three Phase, 60 Cycle

HP	Speed	Volts	Make	Type
300	600	440	G.E.	IM-3 brg.
300	600	440	Whse.	CW
100	900	220/440	Whse.	CW
75	900	220/440	G.E.	ITC-5013
*60	350	220/440	G.E.	MT-504Y
52	900	220/440	G.E.	ITC-5012
50	900	220/440	Howell	SR-446
40	1200	220/440	G.E.	MT-336
40	900	2200	All. Ch.	ARY
40	900	220/440	Whse.	CW-568A
40	720	220/440	G.E.	MT-346
35	1200	220/440	El. Mach.	SK
30	1800	220/440	G.E.	MT-523
30	1800	2200	Whse.	CW-565C
30	900	220/440	G.E.	ITC-5011
30	900	220/440	G.E.	KH
25	1800	220/440	G.E.	I-M
25	1200	220/440	G.E.	MT-522
25	900	220/440	Watson	KE
25	550	220/440	Watson	KH
20	1800	220/440	G.E.	MT-503
20	720	220/440	G.E.	MT-336
10	1200	220/440	Whse.	CI-W326Z
10	1200	220/440	Otis	INT

* Gear head motor.

VARIABLE SPEED DC 230 VOLT MOTORS

Qu.	HP	Speed	Make	Type
1	3/4	500/1800	G.E.	BD-35
3	1	500/1500	G.E.	BD-47
1	1½	850/2250	G.E.	B-254
1	100	900/1100	G.E.	DLC

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle

HP	Speed	Volts	Make	Type
60	1200	220/440	G.E.	KT-343
50	720	220/440	Whse.	CS
40	1800	220/440	Wagner	VRP
40	900	220/440	G.E.	KT-536
40	720	220/440	G.E.	KT-342
35	900	220/440	G.E.	KT
30	1800	220/440	F.M.	B
30	900	220/440	Whse.	CCL
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20	720	220/440	Wagner	BP

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1560 Wghse. 480 v. bleeder)
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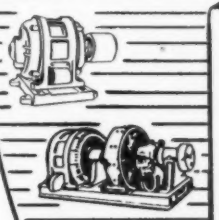

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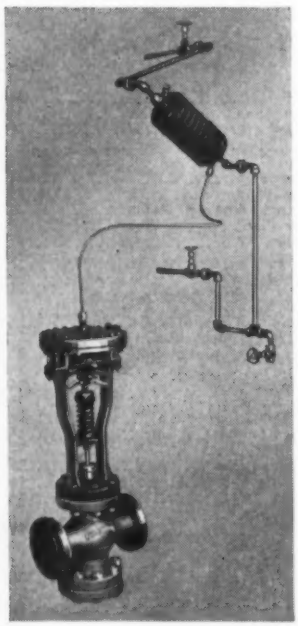

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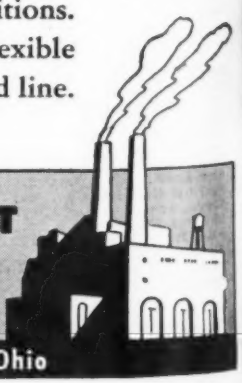

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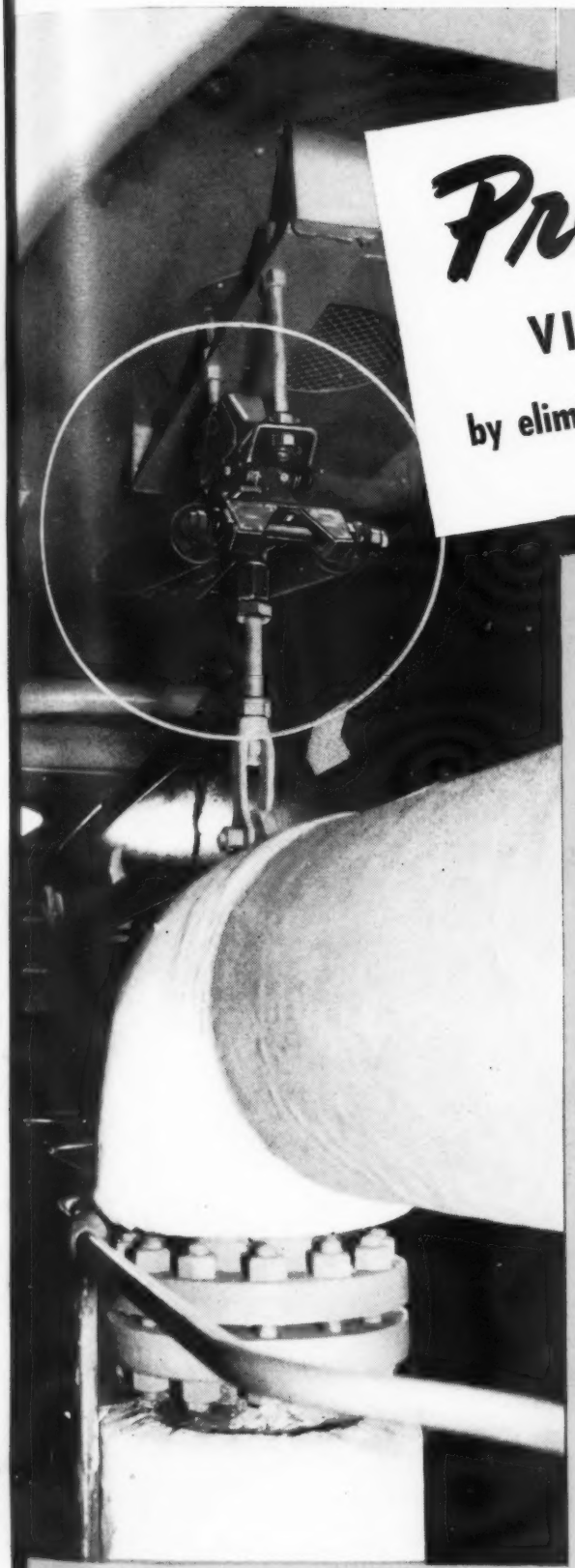

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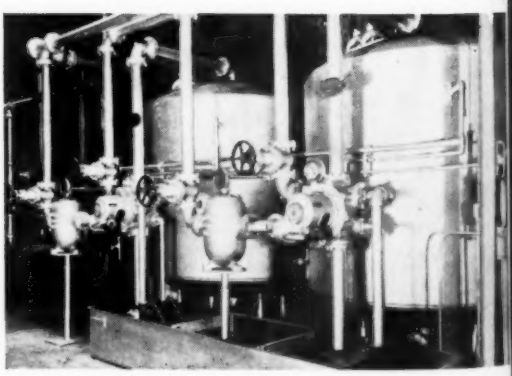

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